THE NINTH CERI INTERNATIONAL OIL AND GAS MARKETS CONFERENCE

September 23-25, 1990
Calgary, Alberta

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OPEC: PROSPECTS FOR STABILITY[1]

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NINTH CERI INTERNATIONAL
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This paper was written in mid-August. Six weeks earlier, the consensus was that the non-OPEC and the small OPEC producers would empty out their reserves, while the big ones worked off their excess capacity. By the mid-1990s the world would depend on a few remaining producers, who would no longer need to cope with a surplus. Prices would resume their long-deferred but inevitable rise.

This is exactly what we heard in mid-1978, when the price, in 1990 dollars, was $22.50. It was a year of stagnating demand, excess supply, and cheating by OPEC members. But all would be well in the long run, when rising demand would outstrip supply. Within a year or two, everyone knew prices were heading up to $100 per barrel. But some funny things happened on the way. For the last four-plus years through June 1990, the price fluctuated between $8 and $20. In mid-year it was down below $13. But by mid-August it was around $26, and...here we go again.

I think the consensus is illusion. The cartel has just scored its third great coup, prices are or soon will be at another peak, and then it will be downhill again. In ten years the downward pressure on price will be greater and more dangerous, and yet another "crisis" just as likely. "Oil crises" result from artificial supply reductions, and from nothing else.

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[1] This essay summarizes a number of papers, published or in preparation, which comprise a project on the world oil market since 1970. The research has been supported by the National Science Foundation, grant #SES-8412971, and by the MIT Center for Energy Policy Research. But any opinions, findings, conclusions or recommendations expressed herein are those of the author, and do not necessarily reflect the views of the NSF or of any other person or group.

THE TEN-YEAR OUTLOOK: THE CALL ON OPEC OIL

Oil reserves are not a one-time stock to be used up, but an inventory, always being consumed and replenished by investment. The inducement to invest--we ought to hire a parrot to keep repeating it.

Paradigm USA The USA (excluding Alaska) is the extreme example or paradigm of the very old oil province. In 1930, "remaining recoverable reserves" were 13 billion barrels. In the next 59 years, the "lower 48" produced not 13 but 123 billion, and had 20 billion left. Equally important, there was no increase in real cost before 1973; and much of the approximate doubling since then was due to the inefficiencies and waste of a frantic investment boom.

No great new discoveries replenished USA inventory after 1930. Discoveries declined deeply, but many small fields were found, and the old ones continued to expand, some amazingly so.

The non-OPEC world outside USA The rest of the non-OPEC world is not as drilled up as was the USA in 1930. They can expect larger expansion of old oil fields, as well as discoveries. Production has continued to rise throughout nine years of declining prices. Even since the crash of 1986, non OPEC reserves have kept rising, and more reserves today mean more production tomorrow.

Multinational companies based in the USA are now spending more overseas than at home, and have larger reserves there, nearly all non-OPEC.

Lower prices helped investment. Before 1981, rising oil prices were extrapolated, and governments demanded the earth of oil companies seeking development rights. Bad economics was and is reinforced by xenophobia and sentiment: "the oil is ours", a family heirloom, not a vulgar asset.

The price decline after 1981 was like a bucket of cold water. Everywhere terms have been improved. Progress is often maddeningly slow, but will continue, as the slower learners watch the quicker ones. Non-cartel output will continue to creep up, while the world painfully re-learns some respect for contracts. In the "high-cost" countries, oil is profitable to produce, ex-tax. Slowly the taxes adjust. Investors spend more, increase reserves, and produce more.

Natural gas is a sleeping giant slowly beginning to stir. In the USA, reserves-added in

1988 were the second highest ever, exceeded only in 1956.[2] Production today is clearly demand- not supply- limited.

Canada was long ruled by a fetish: require 25 years of reserves before permitting exports. With no export market, there was less investment and lower reserve-additions. This "proved" Canada was running out of gas, so it should restrict exports even more. In 1980 the Government of Canada barred exports at $5 per thousand cubic feet (mcf), because the great god Consensus knew the price was going up to glory. Today Canada has learned the lesson, discarded the fetish, and gas exports are climbing at not much over a $2 border price. Gas reserves are growing. In Norway there was once talk of $7 per mcf for "high-cost Troll gas." It will be sold, profitably, at less than half.

In Europe and the Pacific rim, the gas era is just beginning. Border prices in Europe fell by 55 percent from 1985 to 1989 (money of the day). With more non-OPEC oil, and much more gas, most of the increased demand for hydrocarbons will bypass OPEC. The call on OPEC oil will not get back to 31 million barrels daily in this decade. The cartel's environment will not grow more friendly.

THE CARTEL OF SOVEREIGN STATES

Every cartel has two problems: (1) to fix the best price-quantity combination, to maximize wealth, and (2) to divide up the market. There is no permanent solution to either problem. An agreement lasts a while, breaks down, is patched up, then replaced by a new one. It is trial and error. But the cartel of sovereigns has some special strength and special problems.

The price target set by the OPEC Long Term Price Policy Committee in 1978-1980 was the cost of synthetic liquid fuels. That is a clear example of monopoly profit maximizing. Only when oil no longer competes with oil can its price approach the cost of the nearest competitive alternative. The interwar private cartel never dared even dream of such a price.

The OPEC nations found out the hard way that the true ceiling was lower than the cost of alternatives. It was set by consumer resistance: substitution away from oil and other energy sources. This was not known in advance. But everybody admitted that consumer response was very uncertain as to size and timing. A wise policy was to go step by step, raising the price in small amounts to test the waters each time. That was just what the OPEC Committee had recommended: a gradual increase. Whey could the nations not follow their own sound doctrine?

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[2] This fact was masked by the removal of 25 trillion cubic feet in Northern Alaska--which should never have been counted as reserves in the first place.

Short Time Horizons and High Discount Rates

The producing governments cannot wait, because their economies are so dependent on oil. "Non-oil" sectors exist mostly to serve the oil sector, and those who draw oil income. The oil producers are undiversified, hence cannot easily ride out fluctuating incomes.

Moreover, their receipts fluctuate much more than those of a private group. First, OPEC is the swing producer group, restricting oil production to maintain the price. Hence OPEC sales fluctuate more than total worldwide oil sales. Second, these governments are mostly unstable and unruly to each other.

Not as Arabs or Muslims or some other irrelevancy, but as rational economic actors, the OPEC countries must take the money and run. Fifty years ago, some Persian Gulf producers made an emphatic case to an oilman, which he summarized for his company: "The future leaves them cold. They want money now." They still do.

Current-account balances were in chronic deficit in the 1950s and 1960s. A flood of imports washed away the huge 1974 OPEC current-account surplus in just four years. The larger 1980 surplus lasted only two years. Saudi Arabia acquired about $140 billions of foreign assets when the wealth poured in too fast to be spent. Since 1981, about two thirds of it has slipped away. They continue to run budget and foreign exchange deficits.

Suppose, each of you, that your whole income is from a single company. You cannot diversify by selling off any shares. You overspend your income and are heavily committed to reward supporters and friends and buy off enemies. You live in a dangerous neighborhood, and must always fear attack. Of course you will grab for more income now, even if it will cost you much more later.

In theory the cartel should raise prices faster and farther than an unrestrained private monopoly--which is exactly what they have done.

HOW TO CREATE AN ENERGY 'CRISIS'

In 1970, 1973, 1979, and 1990, the price was raised in a four-stage sequence. First, a small output cut, deliberate or created by political turmoil, created a temporary shortage.

An output cut frightened the market into panic buying and holding, for hoarding not use, because nobody knew how long the production cut would last, and everyone feared to run dry.

Second, the spot price soared. Third, each cartel nation, in concert with the others, increased either its excise tax (1970 and 1973), or its official contract price (1979-1981, and 1990), toward or even beyond the spot price. They claimed to be merely "following the Market." In fact the market merely followed their production cuts and threats.

The fourth was the most important step: hold the new line in spite of deficient demand. **Volatility up must not be offset by volatility down.** On January 1, 1974, the take of the Persian Gulf governments was $7 per barrel. Spot prices began collapsing in February, and by midyear there was massive excess current producing capacity, a new phenomenon in world oil. But they kept raising the excise tax, reaching $10.50 by the end of 1974. The Saudi "doves" raised the floor, while the Iranian "hawks" merely followed them. One needs a sense of humor here.

In 1979-1981, there was a pose of being swept along by irresistible market forces. In fact, at all times there was a large amount of deliberately withheld capacity. Despite assurances to the United States, the Saudis cut output in January, and again in April. The price increase held for years, while the excess more than doubled, because the OPEC nations held down output.

In 1990, the price rose steeply in July despite overproduction and overflowing inventories because Iraq threats scared the market. Then, like many enforcers, Iraq decided to use its muscle, and seized Kuwait. This blocked out about 4 million barrels daily, or 3 million not in surplus. Saudi Arabia alone has that much excess capacity, but the OPEC nations wait. Their first concern is to nail down the new high price structure, and I expect them to succeed.

Holding the price line, and reining in production, are difficult. Hence the volatility since 1970, which will remain.

THE BOGEY OF INSUFFICIENT CAPACITY

When the world oil industry was much more competitive than it is today, there was very little excess capacity, and an 8 per cent annual growth rate quickly dissolved whatever excess might accidentally appear.

Since 1973 there has been much excess capacity. Yet in the consumer countries, there is an obsessive fear of insufficient capacity. In the 1970s, the United States State Department, the Central Intelligence Agency (CIA), the Department of Energy (DOE), and the International Energy Agency (IEA) kept warning us of gaps ahead, 20 million barrels daily, 8 million, whatever.

Today we are warned that the world must have another 6 million OPEC barrels daily, installed in the next five years. OPEC is said to need $60 billion, or $10,000 per daily barrel, and where will they ever find the money? Let us reflect!

First, even at a $15 price the annual return is about 50 percent.[3]

Second, $10,000 per daily barrel may be a bit high even for the USA and the UK North Sea. (A recent Soviet estimate is $11,000.) For Venezuela, not the lowest cost OPEC producer, it is "only" about 5-6 times too high. Saudi Arabia has announced plans for increasing capacity by 7 million barrels daily, spending $13 billion. This is exaggerated by an inflation allowance, and covers much gas gathering and a pipeline. Even so, it is only a fifth of the fabled $10,000. That number deserves to be laughed right out of court. The constant repetition shows how badly off-track is most discussion of world supply.

Third, despite current excess capacity, which is the only reason why prices were so weak, all OPEC nations are expanding capacity. Of course, projects carried out will be considerably less than announced, but capacity will exceed anything they can sell.

Permanent excess capacity The excess will never disappear so long as the cartel remains. Therefore even high demand for OPEC oil will not stabilize the price.

Every member knows that with no excess capacity it gets no respect. A member's bargaining power depends upon its ability to create a nuisance or danger by overproducing to put prices in danger, if it is not treated "right." Therefore every member must provide some surplus capacity, if only to make a credible threat of overproduction. There is no escape from the principle: each member must protect itself by doing what is bad for the group.

"Reintegration" = "Netbacking" "Netback pricing" is the sale of crude oil at a price determined by the market price of products. Thereby the producer can sell some or conceivably all of his quota without price competition at the crude oil level. It automatically matches any rival's lower crude prices, which are speedily translated into lower product prices.

Netbacking subverted cartel discipline in 1986. The Saudis used it only as a last resort, to whip their partners back into line. But downstream integration, such as ownership of refining-marketing facilities, is nothing but permanent structural netback pricing. It will weaken prices because, as the integrated governments hold market share by their built-in netbacking, the non-integrated will retaliate by reducing spot and term prices.

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[3] Assuming the OPEC average price at $15, and operating expenses at $1, annual receipts per barrel of capacity operated are $5110. Elsewhere, expenses are much higher, and the investor must reckon with taxes. Hence the rate of return is far lower.

THE CARTEL REMAINS

The rewards of monopolizing the world oil industry have been so huge that the OPEC nations will make strenuous violent efforts to maintain it. War is part of the process. The Iran-Iraq war was a great help. I have pointed out that prices would improve if Iraq occupied Kuwait. Perhaps the next move South will be by Saudi Arabia. In any case, even if the cartel collapses, it will shortly reappear, perhaps with a partly different membership. At any time that they can settle their differences, they can cut production, and raise prices.

The clumsy cartel But even when in control the cartel cannot fine tune with coarse instruments and fragmentary knowledge. Recent consumption is unknown for months. Inventories in the hands of companies are not known fully, and downstream stocks are a statistical black hole. Members do not release accurate production numbers even to each other. The cartel is flying blind, with several hands grabbing at the controls. Moreover, their short time horizons and high implicit discount rates make them over-react.

I said in 1971 that "the genie is out of the bottle." He still is. The next two decades may be less turbulent than the last two, but they are not likely to evolve smoothly in any direction. The OPEC nations learned some caution after 1980, but these lessons wear off in time. The cycle will continue: meetings---quotas---firm prices---cheating---price declines---threats and promises---meetings...with here and there some drastic political-military moves.

I guessed, four years ago, that the price of Arabian Light would fluctuate between the long-run competitive price around $5.50 and the long-run monopoly ceiling around $28 (both in 1990 dollars). A midway price around $17 is in no sense an equilibrium price, merely the brute average of higher and lower. But the consensus -- a constant up-drift pulled by demand and pushed by supply -- is the last thing to expect.

A LOOK AHEAD AT THE NORTH AMERICAN NATURAL GAS MARKET

Presented by

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A. Introduction

My friends and fellow energy associates; it is indeed an honor to be here addressing you today. With the current Mideast crisis underway, the timing could not be more appropriate for CERI to be hosting an international energy conference.

While my primary area of expertise is considered the natural gas industry—an industry in the United States which for most of its history could be considered insulated from international market forces—events in the Persian Gulf have served to remind us that today the energy industry operates in a truly global environment. Prices, production, and even regulatory policy are shaped by international forces. This is quite a revelation for an industry which once considered the weather—a relatively uncontrollable factor—to be the primary influence on its market.

In fact, on policy grounds, natural gas should play an even more important role in the North American energy arena; the current crisis in the Mideast highlights the need for us to rely less on oil imported from unreliable suppliers and depend more on domestically abundant natural gas. Because natural gas can be substituted for oil in many applications, increased use of natural gas can easily and economically displace imported oil—as well as close any "energy gap" resulting from disrupted world oil supplies. Less reliance on imported oil due to increased consumption of domestic fuels would aid the economy by reducing the trade deficit. Additionally, as the most clean-burning fossil fuel, natural gas consumption should be encouraged over dirtier fuels such as oil. However, policy-makers, consumers, and analysts—remembering the "gas supply shortages" of the 1970's—have questioned whether there is sufficient gas supply and deliverability available in this continent to support a growing market for natural gas. Enron began examining this issue two years ago and feels confident that indeed our natural gas resource base is ample, and increased reliance on clean-burning natural gas should be a cornerstone of any policy to enhance energy security in North America.

The North American gas market—that is the focus of my presentation this afternoon. I will confess that my remarks will center primarily on the U.S. and Canadian markets, with little attention towards our neighbor to the south in Mexico. The United States, which once imported up to 105 Bcf annually from Mexico, discontinued buying Mexican gas supplies in 1984. In fact, Mexico has recently become an importer of gas—importing approximately 10.2 Bcf of gas for the first half of this year. Negotiations are currently underway between Washington, DC, and Mexico City with regards to a U.S.-Mexico Free Trade Agreement. It is possible that such a bilateral trade accord could impact the gas market, but there is not enough information at this date to speculate much on the outcome of such an agreement.

But Canada and the U.S. have a long, intertwined and continuing relationship with regards to gas. While the U.S. consumes and produces more gas than our northern neighbor, the forces shaping the gas markets in both nations are very similar. Canada is once again an important contributor to the gas supply portfolio in the U.S., and with the passage of the U.S.-Canadian Free Trade Agreement, we are assured that this trade relationship will prosper—much to the consternation of some of our American independent producers, I might add. The fact that the independent producers have been so vocal in their opposition to new Canadian gas pipeline projects serves to highlight what an important supply source Canadian gas has become in the United States.

B. Gas Market Trends

The previous decade—the 1980's—can best be characterized as the transition decade for the gas industry. We began the decade with a boom in drilling, predictions of largely controlled but high gas prices, coupled with a government-led gas conservation movement restricting demand. We all know what happened: the "gas supply bubble" was created and has been very slow to disappear. Deregulation at the wellhead was followed by regulatory efforts to instill more competition into the gas transportation sector and even in the distribution segment (e.g., "by-pass" policies). Not only was the gas industry facing gas-on-oil competition, but also found itself with gas-on-gas competition, a situation that exists today. Falling oil prices and continued oversupply of gas kept downward pressure on gas prices.

Canada, supplying over 1 Tcf of gas to the U.S. at the beginning of the decade, found its exports reduced to only 712 Bcf by 1983 largely due to the high government-set export prices coupled with oversupply of U.S. gas. Like the U.S., the Canadian government instituted a more market-oriented policy towards gas, including pricing of exports. This has resulted in 1989 seeing the largest level of Canadian gas flowing into the U.S., and the Alberta export spot price following very closely to the U.S. spot price. A record 1.3 Tcf of Canadian gas was imported by the U.S. in 1989, and 1990 imports are approximately 4% ahead of last year's level, so we can expect this year to set a new level of Canadian gas imports.

If the 1980's were the transition decade for the North American gas industry—moving from a heavily regulated industry in both nations to a more competitive market—what will the 1990's be like? Well let me get out my crystal ball and share how Enron views the gas industry emerging over the next ten years.

Last year Enron launched an extensive study on the gas supply outlook through the year 2000. This study was performed because there appeared to be a broad spectrum of analytical opinions on the future size of the gas market. Predictions ranged from very pessimistic views that the gas resource base is inadequate leading to gas shortages to extremely optimistic views. Our results, published in late 1989, indicate that the U.S. has an adequate gas resource base to meet increases in gas demand that will be experienced over the next 10-15 years as gas becomes the fuel of choice; however, there will be a tightening of gas supplies occuring over the near term which will be followed by a market response leading to increased drilling. Because the current market—as you may be aware, we are experiencing extremely low wellhead prices for gas—indicates a higher level of gas deliverability than our study predicted, we have undertaken an update of our gas supply study which will reflect more recent trends in drilling technology. It may also be necessary for us to revise oil price assumptions as well, in lieu of the Mideast crisis, since crude oil prices drive the search for hydrocarbons and directly influence the price of gas and the fuels that compete with gas.

Under the Clean Air legislation currently pending before the U.S. Congress, and using pre-Mideast crisis oil price projections, we believe the U.S. gas market can grow to 19.2 Tcf by the year 2000—an 11% increase from the 1987 level. During this period, the gas market moves from the current demand constrained environment to being more supply constrained. Deliverability declines in 1991 and 1992, when higher prices begin to elicit a supply response. By 1995, gas production returns to current levels. It is important to note that during the two-to-five year period, there is only a mild contraction in supplies; gas consumption never falls as low as the 1986 level of 16.5 Tcf. There is no "crisis" type shortage, because utilities respond to a tighter gas market by switching fuels. The key result is that although there is a lag in responsiveness, there is a supply response over time resulting from the higher prices for gas supplies.

Canadian imports are an important factor in the increase in gas supplies. Our model shows imports growing from the 1989 level of 1.33 Tcf to 1.7 Tcf by 1995 and up to 1.9 Tcf by the end of the century. Canadian imports will remain priced competitively with U.S. gas supplies. Of course, implicit in the assumption that Canadian imports are able to increase is the assumption that additional pipeline capacity from Canada becomes available. Canadian deliverability into the U.S. currently appears constrained at about 1.6 Bcf per year. There are many pipeline projects pending to increase this capacity, on both the U.S. and Canadian sides of the border (including Enron's own proposed plan to expand Northern Border). Presently, it is regulatory delays on such projects as the Iroquois Gas Transmission project—designed to import 650 MMcfd of Canadian gas into the gas-hungry Northeast—which are limiting the growth of Canadian gas exports to the U.S. Export approval from the

National Energy Board (NEB) is also necessary for Canadian imports to increase. Recent actions this spring by the NEB indicate that such approval will be forthcoming; NEB Chairman Ronald Priddle recently stated that he anticipates Canadian gas supplies available to the U.S. to increase by more than 400 Bcf over the next 2 years.

Let us now turn to the demand side of the gas market equation. We have identified four major growth markets for gas in the U.S. The first, and smallest of these, is for natural gas vehicles (NGVs). When our nations were grappling with how to become more energy independent after the fuel shortages in the 1970's, Canada chose a different route than the U.S. in terms of conserving oil consumed by vehicles. I am proud that the Canadian government chose natural gas to be the preferred alternative fuel for vehicles. Canada offers tax incentives for both converting vehicles to run on natural gas, and on fueling with natural gas. Through this policy, Canada has benefited in not only limiting gasoline consumption, but also acquiring environmental benefits through the cleaner emissions from NGVs as opposed to gasoline-powered vehicles. I understand that there are over 6000 natural gas vehicles operating in Ontario alone today.

The U.S. is behind our Canadian neighbors when it comes to alternatives to our gasoline-driven engines. With a lot of prodding from Canada regarding acid deposition problems caused by U.S. industry, the U.S. is on the verge of passing a major overhaul of the Clean Air Act. We anticipate that this legislation will lead to increased gas demand, as previously mentioned, including through its provisions with regards to alternative-fuels vehicles. Thus the primary growth we see in the residential/commercial markets for gas will be from natural gas vehicles. We project that NGVs will lead to an increase in gas consumption of 170 Bcf by the year 2000. While this is not much on a national level, introduction of NGVs could make an important contribution to solving the air quality problems of our nation's dirtiest cities.

The other major growth markets for natural gas occur in the powerplant sector. First, driven by the current pro-environment fever which has grasped our countries, some electricity generators will turn to clean burning natural gas to increase their efficiency and reduce emissions. For example, we see an increase in natural gas consumption through the use of co-firing technology where gas is consumed in the boiler with coal, leading to greatly reduced sulfur emissions. An additional 400 Bcf of gas will be consumed by the year 2000 for this type of environmental purposes.

Another growth area is through cogeneration projects, where gas is used simultaneously to produce steam and generate electricity. Cogeneration has rapidly gained popularity in the U.S. because of its clean-energy qualities and the need for additional electricity in many regions of the country. While the corgeneration market in the U.S. is an important and growing market, currently consuming slightly more than 300 Bcf per year, there is limited growth for congeneration projects due to the limited number of steam hosts. However, we do predict that the congeneration market will consume an additional 250 Bcf of gas by the year 2000.

While currently only supplying 8% of the nation's electricity, cogeneration projects are beginning to attract more attention in Canada. For example, North Canadian Oils, Ltd., located right here in Calgary, already holds some interest in several cogeneration projects in the U.S. and supplies gas to to several cogeneration projects in Canada; and Westcoast Energy has recently announced plans to build a cogeneration facility to provide power in British Columbia. While Ontario Hydro has been less interested in cogeneration, I suspect that in time they will also recognize the advantages from cogeneration, such as quicker start-up than other power facilities, so that cogeneration will emerge as an important gas market in Canada as well.

The largest growth sector for gas throughout this decade will be from powerplants using more efficient and environmentally favorable combined-cycle technology for electric generation. We assume that not all of the current utility plans to add coal and nuclear facilities occur. Instead, many utilities will elect to install gas-fired combined cycle units to displace older, less efficient units. By the year 2000, combined cycle plants will account for an increase in gas use of 1.1 Tcf from the 1987 level.

In summary, the demand for gas is largely being driven by environmental concerns. We will experience some decrease in consumption, primarily in the residental and commercial sectors, due to conservation; but these declines are more than offset by increases in consumption, especially in the electric generation sector, as gas emerges as the environmentally superior fossil fuel.

C. Price Trends

One of the lessons we all should have learned from the energy experiences of the 1970's and 1980's is what a dangerous business it can be to discuss oil and gas price projections. But since one cannot make market forecasts without some implicit assumptions on price trends, I will broach the tricky subject. Again, I warn you that we have not yet altered our price assumptions in response to the current Mideast crisis. I will mention that unfortunately as of yet, the gas industry has failed to reap any enhanced prices at the wellhead as a result of the current increase in oil prices--further evidence of the continued oversupply of gas.

We do project that over time spot gas prices, selling at a very deep discount relative to today's crude oil prices at the wellhead, will rise relative to oil prices. The Mideast crisis has broadened the differential between oil and gas prices--wellhead oil prices are close to $30/barrel while gas is selling at $1.30/MMbtu. The Monchy border price for Canadian gas is around $1.00/Mmbtu. These gas prices are below last year's level. While we are projecting 1990 U.S. gas prices, for both domestic and Canadian supplies, to be slightly lower than last year, we do anticipate an increase in gas prices beginning in 1991.

As the gas market becomes supply-constrained as outlined earlier, gas prices will rise. Competition with residual fuel oil in the industrial and electric utility markets becomes a major determinant of gas prices as dual-fuel consumers look at alternatives to higher-priced gas, therefore limiting the rise in gas prices. There are three additional factors which will lead to a closer Btu parity between crude oil and natural gas at the wellhead. First, the Clean Air Act amendments will lead to natural gas becoming a premium fuel again relative to residual fuel oil and coal due to its lower emissions of sulfur dioxide and nitrogen oxides. Also as a result of tighter environmental restrictions, customers will be burning lower sulfur content residual fuel oil, so that lower sulfur resids rise in price relative to crude oil. Finally, we assume that pipelines and local distribution companies will either discount their rates to retain the incremental fuel-switching customers or they will establish some type of seasonal rates.

These factors work to produce a U.S. spot gas price of $4.40/MMbtu (in 1988 dollars) by the year 2000—based on the assumption of world oil prices increasing steadily to reach $27/barrel (in 1988 dollars) by the year 2000. Recent oil prices, of course, have been above this level. Most likely, the current crisis will be resolved and oil prices will not remain at these levels. However, we think prices are likely to remain in the $20-$25/barrel range, rather than $15-$20/barrel, and that is the first step in price increases which will get oil prices up to $30/barrel (in 1988 dollars) by the end of the century. These increases in both gas and oil prices provide a significant incentive for producers to increase drilling, thus alleviating the "tight supply" problem as increased gas supplies become available. In fact, we project that gas prices rise to a level high to make LNG imports economically feasible by 1995; as well as justifying significant increases in drilling in the lower 48 states of the U.S.

D. Conclusions

Putting all the pieces together, what do we see? Foremost, the future for natural gas in North America is very positive. The current movement towards environmental sensitivity will lead to increased market opportunities for gas as the industrial and electric generation sectors strive to reduce their harmful emissions. The growth markets of natural gas vehicles, cogeneration, and combined cycle powerplants are all functions of new environmental legislation. The increased demand for gas over the next several years will lead to a tightening of supplies, eliciting higher gas prices, and after a lag; a significant supply response. Throughout the decade, competition with residual fuel oil will become the major determinant of gas prices. Competitively priced Canadian gas will play a growing role in meeting U.S. demand for gas supplies.

I believe the key nugget to be gleaned from our gas outlook is that while there are lags, the drilling industry does have the ability to—and will—respond to higher gas prices leading to increased gas deliverability. With the current less-regulated gas industry and increased dual-fuel capable industrial market, there will be no "shortage/crisis" situation in gas supplies as previously experienced.

This is a very important fact. It should also encourage policy-makers to turn more to the gas industry for assistance in increasing our energy independence. Both the U.S. and Canada have a large reserve base of this clean fossil fuel, and natural gas can and should play an important role is solving the nation's environmental and energy security problems. While Canadian gas imports are part of the U.S. gas supply portfolio, the U.S.-Canada Free Trade Agreement provides assurances that Canadian gas is an extremely reliable source of energy.

There are ways that in the short-run natural gas can alleviate our dependence on oil during the current Mideast crisis. This includes dual-fuel utilities and industrial consumers switching entirely over to gas. But hopefully, one lesson learned from recent activities in the Persian Gulf is that we became complacently dependent upon oil imported from unreliable sources and we need to implement a long-run market-based strategy to reduce that dependency. Several of the actions which could be taken include: streamline the regulatory approval process so that new gas pipeline projects could come online increasing gas supplies to wanting consumers; encourage development of the cogeneration and independent power markets which efficiently produce competitively-priced electricity from natural gas; provide incentives such as through the tax code to encourage domestic oil and gas drilling; reform the regulatory rate process to discourage excessive reliance on the spot market for gas supplies; provide incentives such as through the tax code to use alternative fuels such as natural gas to power vehicles; and encourage research and development of emerging new technologies so that they become economically feasible (such as a gas-fired heat pump).

North America can only win through the increased consumption of natural gas. Higher consumption of natural gas means a cleaner environment—lower emissions of sulfur dioxides, nitrogen oxides, carbon monoxide, and particulates; minimal amount of solid waste, sludge, or water pollution; and no environmental disasters occuring from spills. Higher gas consumption means a better financial position as the trade deficit is reduced. But most importantly, increased consumption of natural gas means a more secure North America in terms of energy supply.

THE ACCELERATING IMPACT OF SOCIETY'S CONCERNS ON THE GLOBAL OIL AND GAS BUSINESS

Remarks by

CONSTANTINE S. NICANDROS
PRESIDENT AND CEO
CONOCO INC.

before the

CANADIAN ENERGY RESEARCH INSTITUTE INTERNATIONAL
OIL & GAS MARKETS CONFERENCE

CALGARY, ALBERTA

SEPTEMBER 24, 1990

Thank you Ted, and good evening everyone. I am honored to be a part of the Canadian Energy Research Institute's annual conference. Uncommon times like the ones we face in the world today highlight the value of the work CERI does, particularly in energy policy matters.

The implications of the Middle East situation demand that we work together so that the world's energy needs can be met as efficiently as possible.

In recent weeks, I have been gratified by the partnership demonstrated between the U.S. government and the majority of the world's oil producing countries. Within this partnership, our industry has played a vital role as the ultimate supplier of the energy that is needed by consumers.

However, there is much more for us to do, and many issues for us to consider in the days ahead. And that is the overall theme for my talk tonight.

Last year, I was asked to chair a task force of industry representatives who would dispassionately examine emerging trends that would have the most serious impact on the global oil and gas industry.

Our purpose was to set up a long range planning effort within the American Petroleum Institute that would deal with these emerging trends.

Before I talk about our findings, I need to explain our definition of a trend.

A trend is an external force that generates risks or opportunities for our industry. Trends reflect a commingling of social, political, economic, and other factors. All create complex and difficult choices for industry.

Do note that I said choices. We do have choices, and making those choices is our responsibility.

We undertook this study at a time when the industry was unperturbed by immediate crises and relatively calm -- probably more so than at any time since the Yom Kippur War in 1973.

In the course of the study, we identified seven trends, which I will name in order of importance from our viewpoint:

First, and foremost, concern about the environment.

Second, conservation of fossil fuels.

Third, the mounting complexity of our relations with governments and other groups that influence regulation of our activities.

Fourth, the growing vulnerability of the economies of industrialized nations to supply shocks caused by increasing reliance on petroleum imports.

Fifth, the integration of the United States into a global petroleum market that shares the economic vulnerability of growing reliance on imports.

Sixth, the belief that substituting natural gas for heavier fuels can fix various problems, particularly environmental ones.

And seventh, the technological uncertainty caused by mounting environmental regulations and possible major changes in engines that consume petroleum products.

In our report, under the heading of "environmental surprises," was the following statement:

> "In the last 25 years, the industry has witnessed numerous environmental surprises -- Three Mile Island, Santa Barbara, Bhopal, Chernobyl, to name a few. These surprises have either accelerated an existing trend, such as Chernobyl and an increased aversion to nuclear power, or have been of trend-altering magnitude, such as Bhopal and tolerance of chemical operations. While identifiable surprises of this nature have a low probability, they can have high impact."

Unfortunately, these words were prophetic. Less than a week after the report was issued, the Exxon Valdez ruptured in Prince William Sound.

This single event altered environmental policies and the way the public will permit us to do our business...perhaps irrevocably.

Several months ago when I agreed to make this speech, it was my plan to deal primarily with the environmental issue and the evolution of Conoco's recognition of, and answer to, the public's concern about it.

But once again, a surprising world event changed my talk and the world's focus...as well as succeeded in bringing all the seven trends together with a clashing force.

Once again, a single major event promises to change our industry....and again perhaps irrevocably.

Iraq's invasion of Kuwait has brought the potential dangers of heavy reliance on petroleum imports to the forefront of the news.

Thus, the environment has been displaced in the headlines by the issue of security of supply.

Is this permanent? I think not.

But recent events illustrate how external trends are capable of intensifying rapidly and causing different degrees of impact on our industry at different times. In fact, I believe these external trends are much easier to predict than the price of crude oil, the rise and fall of stock markets, or changes in GNP or inflation rates!

While one trend may catch up with another, none will go away until we address them. This is because they are too ingrained into the views of society, and it would take a shock of great magnitude to eliminate them entirely.

Our job is to understand these social, political, and economic trends, and ensure that our efforts to deal with one do not eclipse what is required to satisfy another. We must not be panicked to the point that we concentrate all our attention on the issue most prominent at a given moment in time.

For example, in our haste to come to grips with security of supply, we cannot afford to ignore the environment, whether or not it is a front-page issue.

To illustrate the commingling of the trends, notice that calls for conservation have intensified in recent weeks, as have demands for increased use of natural gas -- both identified as key trends in our study.

International considerations -- another identified trend -- have never been so prominent in our business as now because nations have recognized their common interests in protecting access to energy supplies.

In a matter of days, the primary technological focus has shifted from reformulated gasolines to the development of alternative fuels and faster ways to tap new sources of supply. Here in Canada, this is illustrated by the progress being made on bringing the Hibernia Field into development and improving economic prospects for tar sands.

Government involvement -- yet another trend -- figures even more prominently, as price rises in the U.S. have prompted accusations of price gouging, among other things.

In fact, a well-known economist said that the emotive word "gouging" was used more times in August than in an entire season of world championship wrestling!

This telling comment is both slightly humorous and enormously sad.

In my view, the petroleum industry in general has acted responsibly to adjust for the sudden loss of 4 million barrels of oil a day from Iraq and Kuwait. It is a source of immense frustration to me that a great deal of our effort to maintain vital supplies has gone unappreciated to the point of occasional vilification.

However, we have not seen the broad intensity of attacks that we saw in the 70s. I believe that is because the public and the news media today are far better informed.

Nonetheless, there is much work to be done. And the work will require calm minds ready to forge new paths.

For our industry, the challenge is to increase constructive cooperation between ourselves and many segments of the world community.

Some of the things we can do have short-term benefits of increasing supply and decreasing demand.

Others are aimed at the longer term, which is just as important because there is no predicting how long this situation will continue.

I believe that a major responsibility to balance the world's supply and demand for crude oil rests on the United States since it is the world's largest petroleum market. Consequently, the rest of my remarks deal primarily with my home country, and all cost estimates are in U.S. dollars.

First, I will talk about short-term measures.

As the world's most prolific energy consumers, Americans must acknowledge that they cannot depend on the Japanese and the Europeans for all the conservation in the world. We must begin our own conservation measures and we must begin them immediately.

Widely ignored in a plethora of discussion is that a significant amount of oil can be conserved in the short-term without great sacrifice. So far, very few people are taking seriously the government's suggestions for conservation. Maybe this is because the ideas are less than dramatic. Maybe it is because they involve lifestyle changes, though minor ones. Most of us are creatures of habit and resent being inconvenienced with even small annoyances.

Things like car pooling, van pooling, driving at lower speeds, adjusting tire pressure, and using the most energy-efficient car when there is a choice could make a major dent in consumption. Flexible working hours could decrease the amount of fuel wasted in traffic jams.

It is too bad that we cannot keep prices from rising by reducing demand before price forces demand down. I have often said that the best way to keep prices from rising is to act like they already have.

This is my way of thinking about voluntary conservation when it is clearly needed. But it seems impossible to encourage people to drive less if gasoline is cheap. Even after recent increases, Americans spend less than 3 percent of their income on gasoline, compared to about 4 1/2 percent in 1978.

Therefore, to encourage conservation, I believe Congress should increase the U.S. gasoline excise tax at the pump. At today's prices, I believe an appropriate tax increase would be about 25 cents per gallon, which on average doubles all existing excise tax. Over the next five years, the tax increase should be raised to 50 cents a gallon.

I believe this would offer both near and long term benefits. It would immediately encourage conservation, and a significant portion of the revenue should go toward energy development incentives and improvements in transportation infrastructure such as deep-water ports, and highway and bridge improvements.

Provisions should be made to cushion the blow for low-income citizens and those who live in remote areas where long distances must be driven regularly.

Another short-term solution -- an obvious one -- is to increase oil production as much as possible without damage to the reservoirs by infill drilling, reworking old wells, and horizontal drilling.

Certainly Conoco is doing these things. In recent months, we have dramatically increased production through horizontal drilling. Production rates in some U.S. onshore fields have increased by as much as 500 percent. Outside the U.S., production was doubled from a field offshore the Netherlands, and a North Sea platform slated for abandonment had its production re-established with a single well.

Interestingly, since 1980, fewer than a thousand such wells with a lateral length greater than a thousand feet have been drilled worldwide. Clearly, more use should be made of this productive technique.

Now let's turn to solutions specifically aimed at the long-term.

First, we should be allowed to begin environmentally responsible exploration of U.S. prime prospects off our coasts and in wilderness areas that have previously been marked out-of-bounds.

Certainly Canada has shown a much more reasonable approach in this matter than the U.S.

In the United States, the old argument of postponing frontier exploration until we need it is no longer valid. We need it, and it cannot be brought onstream overnight.

A few weeks ago, ANWR seemed to be locked up indefinitely. Since the embargo, it is no surprise that exploration of this area has been mentioned repeatedly -- another evidence of trend fluctuation!

However, the burden is on us to erase the idea that exploration in this area will benefit only the companies that explore there. People need this energy. If people did not need and want energy, there would be no reason for us to be in the business of exploration!

It also falls to us to prove that these pristine areas can be drilled with care and that events of catastrophic proportions can be prevented. The world has clearly spoken -- it will not tolerate accidents caused by sloppy behavior, and rightly so.

I am not pleased about recent news accounts that suggest environmentalists could find themselves on the defensive regarding exploration in sensitive areas. Our sudden and pressing need for added oil supplies should not mean an end to everyone's vigilance in regard to the environment.

I do not seek to put anyone on the defensive about protecting our environment. I do hope to prove through Conoco's actions that we are capable of securing energy while satisfying environmental needs. If there must be a victory in this matter, let all of us be winners.

The second prospect aimed at the long-term concerns natural gas supplies in North America. We should step up exploration and development of this valuable fuel, which offers many advantages for both the environment and energy security. Unnecessary regulations -- among other things -- kept U.S. natural gas prices too low for many years, and cut off incentive for development. We cannot afford to let this happen again.

Since oil is traded in a world market, long-term solutions must include the diversification of oil developments around the world. At the moment, this must mean places other than the Middle East.

Conoco is fortunate to have on the shelf many discoveries outside the Middle East that have the potential to increase world supply. What is lacking is the cash flow to finance these investments.

It is easy for those outside our industry to forget that a mere four years ago, our industry began a downhill ride into a private depression. Many oil producing companies sold out or merged because they saw few opportunities to find and develop oil and gas at prevailing prices. Scores of oil service drilling and engineering firms went bankrupt because there was so little business.

Those that survived did so by the skin of their teeth. Today, their services will cost more money than we have been accustomed to paying because many charged the minimum needed to cover immediate costs and survive another day.

Now, these contractors need more than just cost recovery. They must make a profit to rebuild this sector of the industry.

In the early 80s, there were some 8,000 drilling rigs around the world, excluding those in Eastern Europe, China, and the Soviet Union. Today, less than half of those rigs exist.

Even more worrisome is the dispersion of talent to other occupations -- the displaced drillers, engineers, and other specialists. These people must be reassembled, the industry's capacity expanded, and this must be done rapidly.

Currently, we believe a shortfall exists in world supplies of at least 1 1/2 million barrels of oil a day. Let me provide some perspective on how difficult and costly it would be to attempt to close the gap between supply and demand by expanding supply in the most secure areas of the world.

In the United States, Canada, and the North Sea, industry has discovered on average only about 2 billion barrels a year since 1986. To make up the shortfall I just mentioned, an extra 5 billion barrels beyond what is needed to replace current production would have to be brought onstream -- roughly 2 1/2 years' worth of normal additions to reserves in these areas.

In recent years, finding and development costs averaged $9 to $10 dollars a barrel, but this is no longer the case. Our contractors tell us they would charge 40 percent more to duplicate a project we finished last year in the Gulf of Mexico -- and this was calculated prior to the invasion of Kuwait. This level of increase over two years is roughly consistent with our experience in the 70s.

Yet another source of increased costs we face today is the effort required to protect the environment and improve safety. For Conoco, we anticipate these costs to be many hundreds of millions of dollars over the next 10 years.

Considering how difficult and costly it will be for industry to replace 1 1/2 million barrels of daily oil production, three things seem obvious.

First, we must expand the search for diversified petroleum supplies beyond what we consider the safest areas of the world.

Second, conservation must be a factor in narrowing the world's oil supply gap.

And third, if over-dependence on the Middle East is to be avoided and energy security is to be increased, the price of oil must be higher than it was prior to the present crisis to support escalating costs.

Added cost burdens -- including tightening environmental and safety standards -- make it imperative that governments realize that any profits from price increases of the order experienced during the 70s must not be taxed at rates higher than the current corporate rate.

However, we should expect to be accountable for how efficiently we utilize these profits to expand production capacity and to protect the environment. In fact, we should expect and welcome such scrutiny.

My final proposal concerns a component that falls between short-term and long-term considerations. It is the need for a contingency plan for the United States to minimize the economic hardship of an interruption in oil supplies. Such a plan would encompass all the proposals I have mentioned, as well as bring many more into play.

In times such as these, policymakers cannot afford to merely react to events. We need positive, forward-looking plans and actions to promote energy security. To do less is irresponsible, because today's situation is more serious than the oil shocks of the past. This time -- for the first time -- there is a physical shortage of the world's oil production capacity.

So far, I am grateful that we have not been handicapped in the U.S. by rigid government rules. Such rules not only controlled prices of domestic oil at low levels in the 1970s, but misdirected supplies to areas where they were needed least.

I believe today's situation is manageable if governments, our industry, and the public continue to maintain the mature, pragmatic approach to the problem that has been shown so far.

Whether the trouble in the Middle East is resolved rapidly or lingers for years, the recommendations I have made stand -- in either case -- if the United States is serious about energy security.

Ongoing conservation, alternative fuels, and diversified supply are critical components of this effort. In less than two decades, we have had three very distinct warnings that clearly showed the value of such measures. It is time for us to stop ignoring these warnings.

There is no question that world events place new responsibilities on all of us who represent the worldwide petroleum industry. Our role is to work with our host governments and other constituents to bring about both national solutions and those that will cross ders -- for the benefit of the world.

crisis in the Middle East creates many problems. However, tunities go hand-in-hand with problems if we learn from the akes and missteps of the past and if we understand the al, political, and economic trends at play.

these uncommon times, it is interesting to note how the hinese write the word crisis. They use two symbols -- one means nger, but the other means opportunity.

hank you.

WORLD OIL MARKET PERSPECTIVES:

DEVELOPMENTS SINCE AUTUMN 1989

Presented By

Edward L. Morse
Publisher, Petroleum Intelligence Weekly
New York

NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
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The moderator of the opening panel at these conferences has traditionally had two tasks: introducing the speakers for the first day's session and setting the stage by reviewing oil market developments since the previous conference the preceding year.

This second task has been made easier to some degree than might normally be the case by the events of this past summer. For Iraq's invasion and takeover of Kuwait and the response of the international community to Saddam Hussein's actions have provided a clear break with the recent past, as is witnessed by developments in the oil markets for the past month and a half. The price of US West Texas Intermediate crude averaged US $19.60 a barrel a year ago, climbed to $22.65 last January and fell steadily and dramatically to an average of $16.85 in June -- a drop of more than 25%. Last Friday, WTI traded as high as $35.60 a barrel, 112% higher than in June and 62% higher than the five trading days preceding the Iraqi invasion. And the prospect now is that prices will rise to new records of $40 a barrel or more by year end.

Trading relationships have also been turned on their heads. North Sea Brent and other sweet crudes that normally trade at a discount to WTI are now selling at a premium. "Wet" barrels of WTI, normally priced higher than near month futures are now somewhat cheaper. Refining margins, which were at record or near record levels in most markets earlier in the year are now sharply negative.

And, the key issues in the market place since September 1989 now look quaint and outmoded pre-occupations of a distant past. Let me review just two of them.

First, the decline in prices over the first half of 1990 was set in motion by overproduction by OPEC countries, leading to an extraordinary stock build of perhaps 2.5-million barrels a day world wide from summer of 1989 to this past summer. Reflecting this stock overhang, even if last July's OPEC agreement was to hold, there was a consensus that prices would be relatively weak, with the outlook for a crude oil stock build of 0.5-million barrels a day through the first quarter and a modest stock draw down of an equivalent amount from October 1 through the end of the year. And, futures markets were sharply in contango -- far distant month prices were higher than near month quotations, making it profitable for companies to continue to hold and build inventories. The key issue was just how bearish the market outlook was going to be! Look how rapidly that outlook evaporated, as the world looks to a massive stock drawdown for the rest of this year and into next and a critical shortage of key petroleum products, given the bottlenecks in the worldwide refining industry to processing sufficient amounts of middle distillates and gasoline from a crude stream that has become increasingly sour and heavy. And later this week there were be a key meeting of the International Energy Agency that might well be debating whether strategic stocks owned by governments should be released into the market.

Second, debates within OPEC and the wider oil industry focussed last winter on oil production capacity. That debate was about the pace of restoration to production capacity in Iraq, Iran, Saudi Arabia, Kuwait and Venezuela and the rate of capacity additions in key non-OPEC countries to meet burgeoning world demand and a decline in output in the world's two largest producers, the US and the USSR. At the heart of the debate was the question of whether oil prices were going to hold constant in real terms into the mid and late 1990s, or whether they would continue to erode in real terms or actually increase. And, the general consensus was that if oil prices did increase in real terms later in the decade, any increase would be moderate and certainly would not be warranted for a few years.

As I noted a moment ago, in a sense my task as moderator of the first session has been eased to some extent by the events of the past seven weeks because they appear to have caused a sharp break in the continuity of oil market developments not only over the last year, but over the last decade. And, the relatively pedestrian questions we might have been asking about key issues of supply and demand have now assumed a critical importance and interest that the planners of this conference could scarcely have dreamed of when they first organized it.

But in another sense the tasks before all of us are also now more difficult. There have been a number of critical turning points in the oil sector during the past two decades -- the Tripoli agreements, the Yom Kippur War and the OAPEC oil embargo, the Iranian Revolution and the outbreak of war between Iran and Iraq have rightly been viewed as major junctures, which set the oil sector and the international economies on their heads. Will one be able to say the same about recent events? Have we entered another critical turning point in the history of the world's petroleum sector? Or, in the aftermath of events, when the dust settles, will oil prices fall as dramatically as they have risen and will the apparent discontinuity we have been witnessing appear as a small blip in the historical series of oil prices?

I believe the answer to this question is not as easy as it may appear to be. There is little doubt that if the world was willing to permit Iraq and Kuwait to produce oil, prices would be sharply lower. There is little doubt that someday this crisis will have passed. But it is still justifiable to ask whether we are nonetheless at a major change in era once again in this key sector of the international economy.

Let me conclude my introductory remarks and begin my introduction to this morning's discussion by raising a number of questions that the panelists will be tackling from their different vantage points and will help mold our debate over whether we are in any event now at a critical turning point and whether and how Iraq's actions and the world's response relate to it.

First, a question about supply. OPEC had a capacity to produce about 38-million barrels of oil a day at the time of the Iranian Revolution. At that time, a dozen years ago, the world produced about 65.5-million barrels a day and the call on OPEC was for about 31- to 32-mmbd. When Iran's production fell from 6.5- to 4.5- to 3.0-mmbd and then was shut in, ample supplies were available to replace its output and oil prices at first did not change very much. It took four to six months before a scramble for inventories of crude oil resulted in a major surge in oil prices. Two years later, when Iraq attacked Iran, the world lost another 4-million barrels a day of output (actually even more at the beginning of the war), and oil prices shot up again, before retreating and then crashing later in the decade.

The world moved away from oil, with consumption falling 5.5-million barrels a day between 1980 and 1985; OPEC lost 16.5-million barrels a day of market share, with output falling 53%; and non-OPEC production rose about 10-million barrels a day -- a rise of 30%. Another big boost came from the centrally planned economies, whose total output rose 25% from 12.5- to 15.5-mmbd.

Today's crisis has highlighted the impact of a decade of low investment in the search for new oil. Full replacement of Kuwaiti and Iraqi barrels has been rendered impossible in the short- to medium-term, given the dramatic fall in OPEC countries' output capacity. If world demand is going to continue to rise (and it hit a new record this year surpassing the levels of the late 1970s), where will the oil come from? Will it come from key Middle East producers? And, outside of OPEC, can we expect oil developments to replace declining Soviet and US production and also meet higher increments of demand?

Second, some questions about demand. Oil demand worldwide recovered after 1985, boosted by higher consumption in the booming industrializing countries of the Asian-Pacific Rim, some of which saw annual increases of not just 5% but 10-15%, and in some specific products of 25%. How will demand react to higher prices in the short-term? If prices fall after this crisis is resolved, will the increases in demand for oil of the past half decade continue? And, in key industrial countries, especially the United States, where the children of the post-World War II baby boomers will enter the labor force and become major oil consumers in the next few years, will we see a return to higher and higher gasoline consumption?

Third, some questions about OPEC. There are some analysts who assert that the events of this summer are putting an epitaph on the producer group. And, even if their comments are exaggerated, there is little question but that some key producers in that group have developed significant ties to industrial country markets through vertical integration in the refining and product marketing sub-sectors. To a large degree, the oil sector is less and less divided by the North/South re-distributive issues of the 1970s and increasingly is part of the first, or industrialized world. Will those economic ties now be buttressed by geopolitics in a way that will significantly damp any move toward longer-term price increases after the crisis is over? Some of the panelists with us are pre-eminently qualified to express judgements on this set of issues.

Fourth, there are questions about the structure of the oil industry. I raised an element of this a moment ago in discussing the drive toward re-integration led by Kuwait, Venezuela, Saudi Arabia and Libya during the 1980s. But there is another element as well. In the 1970s some three-quarters of the world's oil reserves, discovered and developed by international companies, were nationalized. Before 1973 only two key producing countries, the Soviet Union and Mexico, barred foreign firms from operating in their countries. Today more than 33% of the world's oil is produced by countries that do not allow foreign companies to operate in them. Yet a significant reversal appears in the works and may be spurred by the events of this past summer. Already Algeria has re-opened its upstream sector. Venezuela has announced plans to do the same. Mexico is flirting with a political formula to provide room for private sector firms. The largest producer, the Soviet Union, is clearly on the way toward a major overhaul of its industry, breaking state monopoly control. Iran has found ways to permit the re-entry of foreign drilling companies. Iraq was about to announce that it too had finally found a way to attract foreign companies, some of them American, to help develop discovered but undeveloped reserves, when it invaded Kuwait. We are clearly seeing a movement reversing the trends of the 1970s, leading to the de-nationalization of the upstream sector. The impacts of this movement are bound to be monumental, whether or not Saudi Arabia and a liberated Kuwait follow suit. But what will these impacts be.

Finally, there are questions about geopolitics, and these issues loom perhaps largest on our minds these days.

It is by no means clear to me how our panelists this morning are going to tackle the issues before us. I will bet, however, that they will do so in provocative and interesting ways.

Outlook for World Petroleum

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The Iraqi invasion of Kuwait and the subsequent tumultuous turmoil in OPEC over whether to raise oil production to offset the loss of oil from Kuwait and Iraq has again raised questions about OPEC's long-term cohesiveness as the dominant power in global petroleum councils and generated concern over where oil prices will stabilize once the current crisis recedes from the world's television screens.

While OPEC is clearly under intense strain, rumors of its demise are premature. However, for OPEC to continue to dominate world oil, the organization must adopt a moderate pricing strategy. Ironically, it was Kuwait's pricing strategy, not Iraq's, that was returning OPEC to the dominant market position it held in the 1970s. If as a result of the current crisis, oil prices stabilize at levels above $30/bbl, within five years OPEC market power will again deteriorate under the onslaught of alternative energy development, enhanced conservation, and an erosion in oil demand.

An examination of the anatomy of the Kuwaiti crisis is instructive for what it demonstrates about the locus of power in OPEC both now and in the future. In 1988, with Iraq's defeat of Iran in the Gulf War, Iraq clearly emerged as the dominant military power in the Gulf. The war however left Iraq deeply in debt and in need of generating revenue to rebuild its society. Despite Iraq's preponderant military power, it knew that in OPEC councils, its 100 billion barrels of oil reserves placed it on a par with Abu Dhabi (92 billion), Iran (93 billion), Kuwait (97 billion, including its share of the neutral zone) and far behind Saudi Arabia at 255 billion barrels.

While there were a myriad of reasons for the invasion of Kuwait (repudiation of $10-12 billion war debt, gaining access to Bubaiyan Island and thus access to the Persian Gulf and disgruntlement over Kuwait's sucking out Iraqi oil ($2.5 billion) at the South Rumalia oil field, there can be no doubt that Iraq's primary motivations were (1) to stop cheating on oil quotas by Kuwait and the UAE which threatened to collapse the price of oil and (2) to emerge as the primary challenger to Saudi Arabia's domination of the world petroleum market in the 1990s.

The outcome of the July 25, 1990 OPEC meeting posed a direct threat to Iraq. Though the trade press made much of the differences between Iraq's demand for oil at $25/bbl and the rest of OPEC supporting $20/bbl until a compromise was worked out at $21/bbl, in reality, Iraq knew that prices could not even be sustained at $20/bbl in the wake of previous OPEC over production and the likelihood that cheating would continue. It should be remembered that at the time of the meeting spot prices were finding it difficult to achieve stability at $15-16/bbl. Indeed, during the first seven months of 1990, the spot price for OPEC's seven most widely traded crudes averaged $16.84/bbl versus the $18.00 target price. In July, it had fallen to $15.68/bbl with the prospect of further decline. This was clearly intolerable to Iraq.

While Iraq clearly miscalculated the impact that the invasion of Kuwait would have on galvanizing world opinion against it, the invasion was not the act of madman but a cold calculated decision that by a single stroke Iraq would achieve its long standing goal of becoming the dominant force in the Gulf. From the evidence available, it appears that the failure of U.S. diplomatic officials to state categorically that the U.S. would oppose any intervention in Kuwait may have encouraged Saddam Hussein to launch the invasion.

With the acquisition of Kuwait, Iraq overnight (1) boosted its reserves to 194.5 billion barrels, in comparison to 255 billion barrels for the Saudis, (2) acquired a near term production capability of 5.7 mmbd and the prospect of being a 9.5 mmbd producer in the 1990s versus 10 mmbd for Saudi Arabia, (3) Iraq gained control of 5.2 billion barrels of oil reserves in the neutral zone, and 400 mbd of production – production which in the current market was Japan's single largest crude supply source; (4) Iraq gained control of significant upstream investments in a dozen countries, major downstream world class refineries, significant retail markets in Western Europe and sizeable investments in petrochemicals, tankers, etc., not to mention the prospect of controlling $100 billion in Kuwaiti assets abroad. While we now know that Saddam Hussein's gambit did not work, surely, he must have decided that the opportunities were worth the risk.

Iraq realized that during the 1990s, at least five and possibly more OPEC countries will cease being significant oil exporters and that the locus of world oil power will reside clearly in the Gulf. With the acquisition of Kuwait, combined with its raw military power, Iraq would emerge as a significant world actor and the dominant power in the Middle East.

Ironically, it is Kuwait more than any other member of OPEC which has understood that the 1986 oil price collapse occurred because OPEC raised prices too fast in the late 1970s and early 1980s. Indeed whereas OPEC produced 31.0 mmbd in 1979, by 1985 this had plummeted to 15.5 mmbd as coal, nuclear power, natural gas and end use efficiency captured 5 mmbd, 4 mmbd, 1 mmbd, and 5.5 mmbd respectively from OPEC's share of the world market.

With the oil price collapse in 1986, demand for OPEC oil soared as the low price for oil led to a surge in demand in industrial boilers, electric power generation and Third World transportation markets. The implications of this were not lost on Kuwaiti strategic planners and the OPEC Secretariat. With low oil prices, OPEC began to recapture the market, gaining nearly 6.5 mmbd of market share between 1985 and the eve of the crisis. With demand for OPEC oil rising at nearly 1 mmbd/annum prior to the Kuwaiti invasion and projected to continue well into the 1990s, clearly OPEC was back in the driver's seat. Indeed, concerns were already being expressed about how OPEC could raise the $60 billion in revenue projected to be needed to develop the new productive capacity to keep global oil supply/demand in balance in the 1990s.

In the current market environment, it is at best hazardous to predict where global petroleum prices will ultimately settle. Likewise, any price forecast, however accurate, which is based on econometric models will not necessarily reflect other market realities, e.g., the fact that downstream markets prior to the crisis were becoming less flexible owing to reductions in excess refining capacity especially in the United States and the fact that increasingly most spare capacity is designed to process heavier grades of crude oil;

bottlenecks in upgrading facilities, pipeline capacity and port facilities; and growing technical difficulties in producing petrochemical products in conformance with ever tightening environmental regulations and standards.

Furthermore, the deterioration of the U.S. and global economy and the increasing likelihood of a significant recession makes forecasting especially difficult though clearly, past experience, as noted above, offers some insights. On September 21, 1990, the U.S. Department of Energy released its supply/demand oil market forecast for 1995 based on its oil market simulation model.

The model starts from 1990 prices and forecasts the incremental impact on free world demand, non-OPEC, and OPEC supply at various real oil prices in 1995. The model is predicated on an OPEC production level in 1990 of 23 mmbd.

1994-95 OIL FORECAST*

Real Oil Prices	Free World Demand	Non-OPEC Supply	OPEC Supply
$30	-2.5 mmbd	+1.5	-4
$25	0	+1	-1
$20	+2.5 mmbd	-1	+3½

* I am indebted to Adam Sieminski of Washington Analysis Corporation for sharing these numbers with me prior to the official DOE publication.

With spot prices on September 20 in excess of $34/bbl and tensions in the Middle East rising, one may query the validity of many DOE's assumptions. Clearly, how and when the current crisis recedes will have a major impact on where prices initially level off. Specifically, the course of the current crisis will determine: how far global stocks have been drawn down; how much surplus OPEC and non-OPEC production has been put into the market to offset the loss of Kuwaiti and Iraqi oil; whether oil production facilities in Kuwait, Iraq, and Saudi Arabia and the UAE have been destroyed; and the impact that higher prices may have in plunging the world economy into recession reducing demand for oil. Likewise, if global oil demand falls substantially owing to sustained high oil prices, concern over the bottlenecks in the global oil refinery and logistical system will slow providing additional time for investment to offset at least some of the growing concern about the miss match between demand for light crude oil and petroleum products and existing refining capacity. Furthermore, the energy situation in China, the USSR, and Eastern Europe remain significant wildcards that will impinge on the DOE's and other price forecasts.

THE SHORT TERM OIL MARKET

The Iraqi invasion of Kuwait removed nearly 4 mmbd of crude oil and petroleum products from world export markets. In addition, global petroleum supply lost access to 700 mmbd of highly sophisticated Kuwaiti export refining capacity and about 150 mbd of refinage capacity in Iraq.

While estimates of OPEC and non-OPEC spare capacity vary widely, a recent assessment from the Middle East Economic Survey (September 3, 1990) suggests that by the end of 1990, OPEC could produce the following volumes in relation to the OPEC quota.

PROJECTIONS FOR LIKELY OPEC CRUDE OUTPUT
(Thousand b/d)

		Likely Output		Diff. from Quota	
	Quota	Sept.	Year-End	Sept.	Year-End
Algeria	827	800	800	- 27	- 27
Ecuador	273	280	280	+ 7	+ 7
Gabon	197	270	270	+ 73	+ 73
Indonesia	1,374	1,270	1,300	- 104	- 74
Iran	3,140	3,200	3,250	+ 60	+ 110
Iraq*	1,500	400	400	-2,740	-2,740
Kuwait**	1,233	300	300	-1,200	-1,200
Libya	1,611	1,400	1,450	+ 167	+ 217
Nigeria	371	1,850	1,900	+ 239	+ 289
Qatar	5,380	400	400	+ 29	+ 29
Saudi Arabia	5,380	7,650	8,200	+2,270	+2,820
UAE	1,500	2,000	2,100	+ 500	+ 600
Venezuela	1,945	2,295	2,445	+ 350	+ 500
Total	22,491	22,115	23,095	- 376	+ 604

* Likely output comprises 400,000 b/d for local consumption.

** Likely output comprises 150,000 b/d for local consumption plus 150,000 b/d share of offshore Neutral Zone production.

Source: Middle East Economic Survey

At the same time, it is estimated that non-OPEC producers could produce an additional 500-600 mbd. With high oil prices likely to have a significant dampening effect on global demand, the world should be able to have access to needed oil supplies if stocks are managed effectively, significant hoarding does not occur, and oil installations are not destroyed. In this scenario, IRG agrees with the just released IMF World Economic Outlook that oil prices will fall back to around $26/bbl in the near term and into the lower $20s by late 1991 barring an escalation in hostilities. If hostilities ensue, prices in the $45-$65/bbl level are likely if oil production facilities are destroyed.

Nonetheless, it should be noted that there is little room for maneuver in any of the above caveats occur. According to a recent assessment by the OPEC Secretariat, with the loss of Iraqi/Kuwaiti supply, global commercial stocks, above the minimum operating level will last for 171 days. This represents the difference (731) million barrels between total global commercial stocks 4,431 million barrels and a minimum operating inventory level of 3,700 million barrels. With global strategic stocks at 850 million barrels, clearly the world has some additional cushion since even if these stocks were drawn down at a rate of 50%, 99 days of supply would be available (MEES, August 27, 1990).

However, assuming any significant shortfall in OPEC and Non-OPEC countries raising production, demand remaining relatively constant (which it clearly will not), and any major destruction of Gulf oil installations the market could become tight.

Returning to the DOE forecast, one can see that the supply/demand projections for 1995 raise vexing problems for OPEC. If DOE is correct and a sustained real oil price of $30/bbl dropped OPEC oil production to 19 mmbd, OPEC would earn $570 million/day, while at 20 mmbd OPEC would earn (26.5 x $20) or 530 million/day. However, if real oil prices were sustained at $30/bbl to 1995, structural changes in the world energy market would commence which could crash the demand for OPEC oil in the period 1995-2005. While a repeat of the events or 1979-85 seems unlikely given the greater importance of transportation fuels rather than industrial boilers and electric power demand, OPEC should tread with great caution if it wishes to avoid unleashing devastating market forces.

At the same time, were the price to return to $20/bbl, OPEC will need to spend billions of dollars on new productive capacity to keep the market fundamentals of supply and demand from ratcheting the price upwards. This, of course, leaves unanswered the question of who will become the dominant actors in the Gulf or whether even greater dominance of the world petroleum market by Saudi Arabia is in the interest of Japan, the United States, Western Europe, or even Saudi Arabia itself.

Clearly, OPEC is at a crossroads. If the current crisis ends and the price of oil falls into the low 20s or less, OPEC will remain in the driver's seat for the foreseeable future though it will have to make substantial investments in new productive capacity. However, if hostilities ensue and oil production facilities are destroyed and/or market forces keep the price of oil at $30/bbl or higher, demand for oil will erode, market fundamentals will take over and by 1995-2000, another oil price collapse will loom on the horizon.

WORLD OIL DEMAND IN THE MID-90s

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WORLD OIL DEMAND IN THE MID-90s

Introduction

Good morning, ladies and gentlemen. I have been asked to speak to the prospects for world crude oil demand over the next five years. As with all the topics on this mornings panel, this issue is considerably more difficult to deal with than was the case just a few weeks ago.

The events taking place in the Middle East have many implications for players on both the demand and supply side of the oil market. On the supply side, higher prices will prompt some organizations to bring back plans for high-cost crude oil sources and nonconventional crude oil alternatives. Drilling budgets will be revised in light of improved cash flows and revised crude oil price outlooks.

Governments around the world will renew their concerns over the stability of world oil markets and degree of exposure to Middle East politics and Middle East uncertainties. Security of supply, energy self-sufficiency, exposure to uncertain market conditions, all will come back into play.

Consumers will see higher petroleum product prices--many have already done so in many parts of the world--and will become increasingly concerned with reliability of energy supplies at predictable prices. Alternative fuels, such as natural gas and electricity, will be looked upon with increasing favor. Oil price instability will tend to reinforce the existing concern over the environmental impacts of hydrocarbon combustion, prompting a renewed dedication to the search for alternative, environmentally friendly fuels.

All of these factors will come into play over the next year. Many of the options pursued during the 1979-81 crisis will be resurrected, perhaps proving once again how inaccurate is the short-term memory.

But, having said all of this, one can examine world refined product demand over the next five years with relative certainty. As I will suggest later in this presentation, the process of change in demand composition is slow and deliberate, operating through the process of capital stock replacement. Developments over the next year or two will have little impact on the mid-term product demand profile.

To many of you, this may signal the beginning of an extended coffee break. However, there are some insights into the role of demand behavior and predictability of demand response which will be useful in gauging the reaction of prices and the oil market to the inevitable resolution of tensions in the Middle East. To do so, one must first address three questions:

(i) What has been the behavior of crude oil demand in the past, and what lessons can be drawn on for future developments?

(ii) What factors are likely to impact on crude oil demand over the 1990s, and what is the likely magnitude of the impact?

(iii) Which of the above factors are most likely to show up?

Historical Trends

(FIGURE 1) This slide provides a profile of crude oil demand trends over the last decade. The historically dramatic demand effect following the 1979-81 oil crisis--four years of negative demand growth--was the outcome of a unique set of circumstances. The perception drawn from the experience of the 1970s was that the global community appeared to have ignored the first oil price shock five years earlier, with demand growth in the 5-6 percent per year range over the last half of the 1970s following a brief downturn associated with the economic slowdown of 1973-75.

In reality, industry and governments worldwide were reacting to the relative price adjustment, through the development of off-oil conversion processes, multiple fuel technologies, product tax adjustments, and pursuit of combustion processes which either eliminated refined petroleum products in favor of other energy sources or used energy products in a more efficient manner.

The second price shock spurred the deployment of these technologies, many of which were already well advanced, and prompted the adoption of numerous housekeeping measures to reduce the unnecessary use of energy. Along with the more severe economic downturn following the second oil price shock, these factors combined to drive demand growth down for four consecutive years.

Since 1986, global oil demand growth has been in the 2-2.5 percent per year range. It is instructive to note that the dramatic oil price decline of 1986 did not register an equally dramatic increase in crude oil product demand. In some countries, this was due to government actions designed to maintain real price stability, through the implementation of a larger fiscal wedge between the burner-tip price of the products and the declining crude oil price.

This action made a certain degree of sense for those countries which were particularly exposed to the vagaries of world oil market developments. After all, their economies had successfully adjusted to $20-22 per barrel energy prices, and the policy makers had no desire to see a return to the voracious crude oil appetites of the 1960s and 1970s. Of greater importance to the current situation, these actions were not accompanied by any significant public outcry that the benefits of lower energy prices were not being passed on to the consumer.

Rather, the consumer appears comfortable with the pursuit of a degree of autonomy from the oil price roller-coaster. In Europe, where the spectre of oil market disruptions and dependence on Middle East crude oil supplies are more prominent in the energy dialogue, consumers are willing to pay an insurance premium--in the form of higher product taxes--in exchange for development of alternative energy supplies and at least limited protection from disruption. The current crisis in the Persian Gulf will likely result in similar actions in North America, as policy makers attempt to gauge the degree of risk aversion among their constituents and adjust the "insurance premiums" accordingly.

(FIGURE 2) Focussing on the latter half of the 1980s, it can be seen that the growth in crude oil demand has varied considerably across regions. As shown in this figure, world oil demand increased by 10 percent over the 1985-89 period. However, growth in the developing countries was roughly double that rate. In certain of the newly industrialized countries, such as South Korea, oil product demand increased by almost 60 percent over the second half of the decade.

The conclusion to draw here is that petroleum product demand growth is closely linked to both the rate of growth in economic activity, and to the stage of economic development in the country or region in question. Projections for above average economic growth for the developing and newly industrialized countries over the first half of the 1990s--ranging from 3.5 to 4.5 percent per year--carry projections for petroleum product demand growth that may, in fact, exceed these rates.

(FIGURE 3) Finally, one must consider the changing composition of world oil demand. As shown in this figure, the demand barrel has become considerably lighter, or whiter, over the last decade. In all regions, the share of gasoline and "other" products in total product consumption has increased, in some cases quite significantly. In the United States, gasoline demand accounts for over 42 percent of total product demand, versus 37 percent in 1979. For the OECD as a whole, gasoline's share has increased from 28 percent in 1979 to over 33 percent in 1989.

Most dramatic has been the success in the developed countries in moving away from the heavy end of the product slate. The share of fuel oil in total product demand in the United States has fallen from 17 percent in 1979 to less than 10 percent in 1989. A component of this reduction has been attributed to gas-on-gas competition and depressed gas prices. In fact, heavy fuel oil demand in the U.S. has benefitted from the weak prices of early 1989 and 1990, with significant demand growth in the electricity generation market. It can be expected that this dual-fuel market will be among the first to switch back to gas consumption.

Japan has decreased the share of fuel oil in total product consumption from 47 percent to 27 percent over the same period. Less dramatic but still significant reductions in heavy product consumption have also been recorded in the developing countries.

From this brief examination of past trends, we can draw a number of conclusions. First, crude oil demand does respond to short term movements in product prices; the majority of adjustment appears to take place within the first nine months following a price adjustment.

Second, crude oil demand remains linked to economic growth, with the degree of linkage dependent on the industrial structure of the country or region in question. Thus, similar economic growth rates will carry smaller percentage gains in crude oil consumption for the developed countries than for the developing and newly industrialized countries.

Third, the longer term adjustment to crude price changes must come through the expensive and lengthy process of capital stock rollover. Gains made in the 1980s in energy efficiency and less energy intensive production processes will continue to be felt through the 1990s, as old capital is replaced and the industrial structure of, in particular, the developed economies continues to drift away from heavy industry. However, energy inputs constitute a relatively minor component of total production costs in most industrial and manufacturing processes; thus, it is unlikely that this process of capital adjustment will be significantly accelerated by increases in petroleum product prices.

Fourth, the petroleum products market is increasingly becoming a transportation fuels market. This is certainly the case in North America and is a robust trend globally. The results of a comprehensive CERI study dealing with the technical, economic and commercial potential for alternative transportation fuels, to be released later this fall, suggest that market penetration for these fuels is limited under the existing relative price and market structures. Limited scope for fuel substitution over the next decade in turn suggests that energy policy relating to oil demand and consumption will increasingly be viewed as transportation policy

Current Product Demand

(FIGURE 4) This figure shows the volume and product composition of world crude oil demand in 1989. The OECD countries continue to be the dominant consumer of petroleum products, representing 56 percent of total product consumption. The developing countries accounted for 22 percent of world crude oil consumption, with the USSR and Eastern Europe accounting for 17 percent.

On a product basis, gasoline demand accounted for almost 30 percent of total product demand in the OECD and developing countries. The largest product category was middle distillates, representing 35 percent of product consumption, with fuel oil and "other" products accounting for 18 percent each. Again, the graphic underlines both the geographic variation in volume of product consumption, and the dissimilarities in composition across regions.

This brings us to the 1990s. The majority of analysts had been predicting a fairly stable period of demand growth over the first half of the decade, in the 1.5-2.5 percent per year range for the non-centrally planned economies--we have yet to develop an appropriate descriptor for the new socio-political environment, although speaking of "the EE7, USSR and China" appears to be taking hold. This translates into roughly 1.0 million barrels per day of incremental crude oil demand.

Within this conventional scenario, the trend away from heavy product consumption would continue, as would the growth in total product share being accounted for by the developing countries. In a study released this spring, the Canadian Energy Research Institute examined a reference case based on consensus views regarding economic growth rates, interest rates, and other economic variables, and a gradual expansion of OPEC production over the first half of the decade.

Our analysis suggested that world crude oil consumption would exceed 71.5 MMb/d in 1996, with the OECD and developing countries accounting for 56.3 MMb/d or 78 percent of total demand. Product shares would have changed slightly, with gasoline accounting for 31 percent of total demand and fuel oil falling to 15 percent of total demand.

The question which most market participants are now posing is, of course, how current events in the oil market are likely to affect this outlook. To gauge this issue, we developed an alternative scenario based on two assumptions:

(1) World oil prices average $23.50 per barrel (WTI) in 1990, the current crisis is resolved in first half 1991 with a subsequent price crash, yielding a crude price of $17.00-$18.00 per barrel for 1991, and prices recover to the $20-$22 per barrel range over the 1992-96 period.

(2) The spike in world crude oil prices is sufficient to tip North America into a two-year recession. Economic growth in Western Europe and Australasia is weakened relative to earlier projections, but they avoid an economic recession on the strength of fiscal, economic and trade liberalization--in the case of Europe--and continued trade growth--in the case of Australasia. The developing countries experience positive but lower growth rates over the first half of the decade than were earlier forecast.

(FIGURE 5) This figure shows the impact on world oil demand of this revised scenario, relative to our previous reference case. Oil demand in 1990 is virtually unchanged from 1989 levels, compared to a projected growth rate of 3.0 percent under the reference case. The impact on demand of the decline in crude prices in 1991 is partially offset by the slowdown in economic growth, with oil demand increasing by approximately 2.0 percent.

The impact of the economic recession in North America and related economic slowdown elsewhere in the world, combined with the return of crude oil prices to the low $20 per barrel level, yields crude oil demand growth below 1.0 percent per year over the 1992-96 period. Oil demand in 1996 is roughly 2.5 MMb/d below the reference case level, and only 5 percent, or 3.0 MMb/d, above 1989 levels. Total world oil demand in 1996 is forecast at 68.7 MMb/d versus 71.5 MMb/d under the reference case scenario.

Conclusions

In discussing developments in crude oil demand over the next five or six years, it is possible to abstract from many of the longer-term technological and policy developments which appear poised to impact on the oil market. Three ready examples are natural gas penetration in the European and Pacific Rim energy markets, the economic potential and future of Eastern Europe and the Soviet Union, and environmental policy developments. Fortunately, we will have the opportunity over the next two days to hear from authorities on all of these issues, and perhaps better gauge the likely long-term impacts which developments in these areas may have on the oil market.

In the medium-term, the key uncertainty in projecting crude oil demand lies in the resolution of the current Middle East crisis. I have offered one possible scenario from among the many potential outcomes. As a generalization, the longer is the confrontation extended, the greater will be the initial negative impact on demand, the further and more prolonged will be the price decline following the resolution, and the longer will be the recovery in demand to 1990 levels.

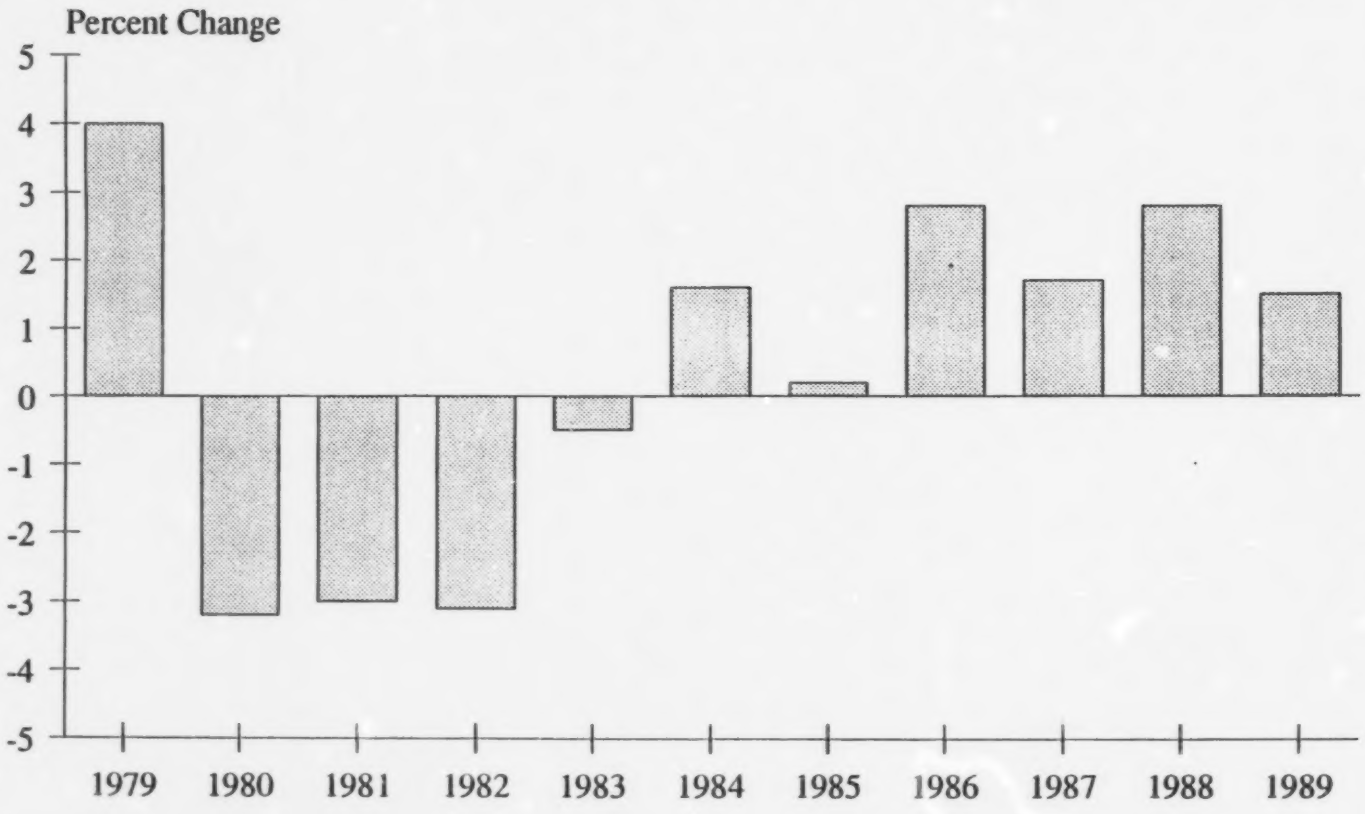
If a military confrontation decides the outcome of the current crisis, the period of high prices will be prolonged to the extent that production facilities are impacted. The increase in productive capacity elsewhere in the world, which a prolonged high price scenario would generate will, in turn, contribute to a price cycle similar to that of the 1982-86 period. It would seem reasonable to suggest that the greater is the expansion of capacity, the deeper and more prolonged will be the subsequent price decline.

The reality of supply and demand response to relative price changes must not be ignored in strategic planning within the industry. Certainly Saudi Arabia, in its pursuit of increased OPEC production volumes during the current crisis and expressed desire for oil price stability, is very aware of the damage to crude oil revenue which would accompany a further round of long-term demand adjustment to high oil prices.

As a closing thought, there is another element in this near-term scenario which may come into play. Crude oil and product prices are escalating at a time when concern over the environment is placing increasing pressure on policy makers to take actions to curb the growth in hydrocarbon consumption. It is feasible that governments, in response to the oil price decline which will likely follow the resolution of the Middle East crisis, may act to maintain real product prices at their higher levels through increased product taxes. The revenue implications of this newest "sin tax" would be considerable. As important, public opinion may be positioned to accept both the environmental and off-oil rationales for such an action. That the temptation will exist is not in doubt. The action itself could spell a lengthy period of weak crude oil prices and renewed pessimism for an industry that has been waiting to turn the corner.

FIGURE 1

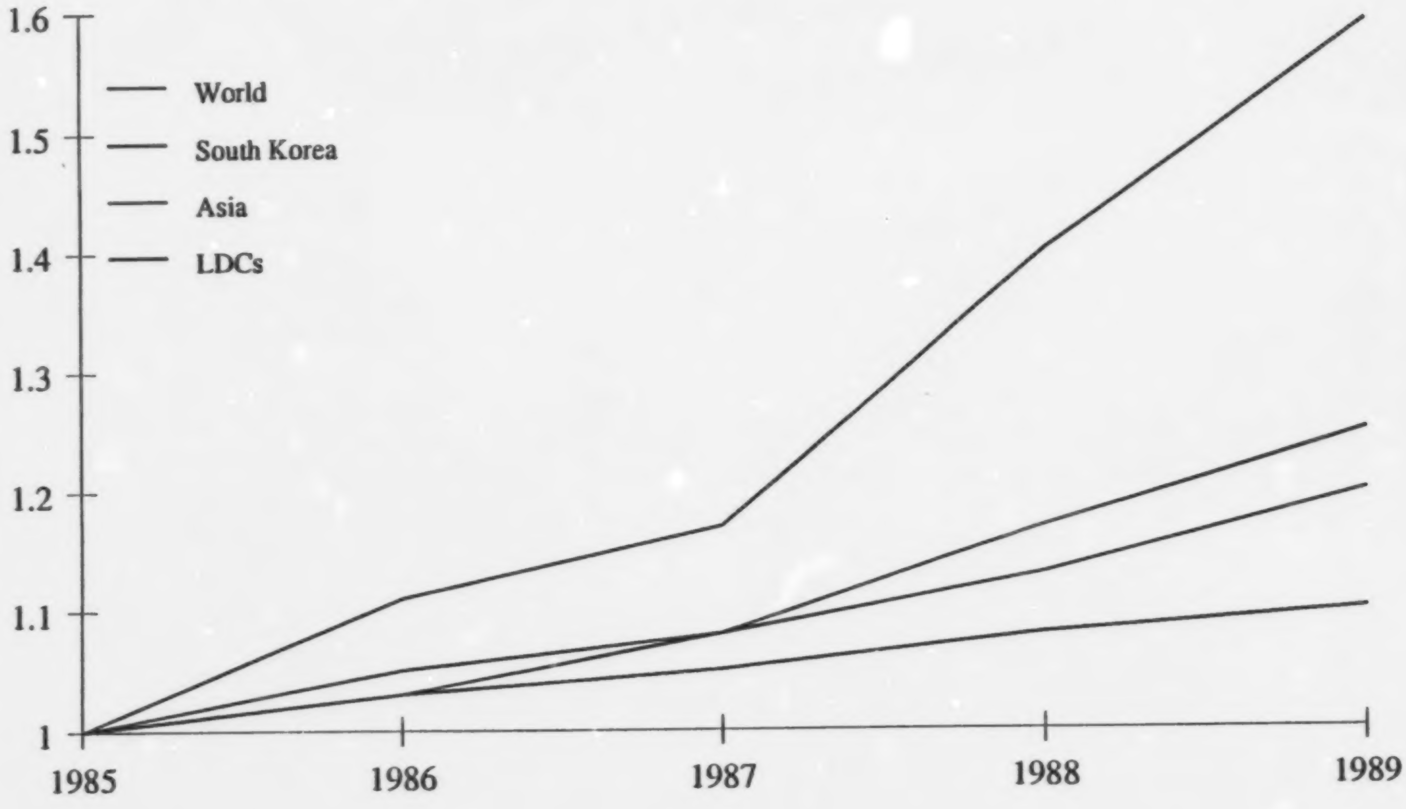
World Crude Oil Demand
1979 - 1989
(percent change, year-over-year)



SOURCE: BP Statistical Review, CERI.

FIGURE 2

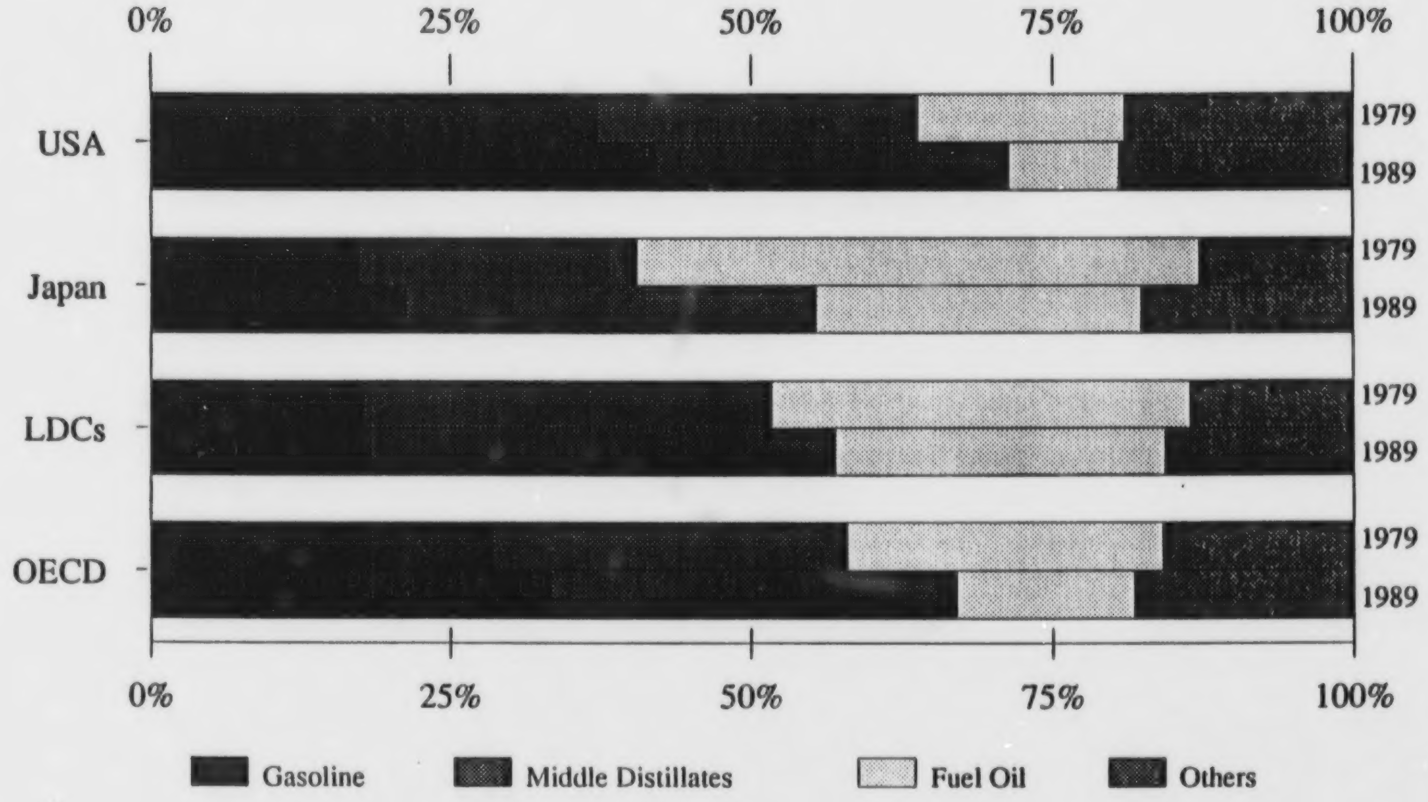
Crude Oil Demand Growth
Selected Countries, 1985-1989
(1985 = 1.0)



SOURCE: BP Statistical Review, CERI.

FIGURE 3

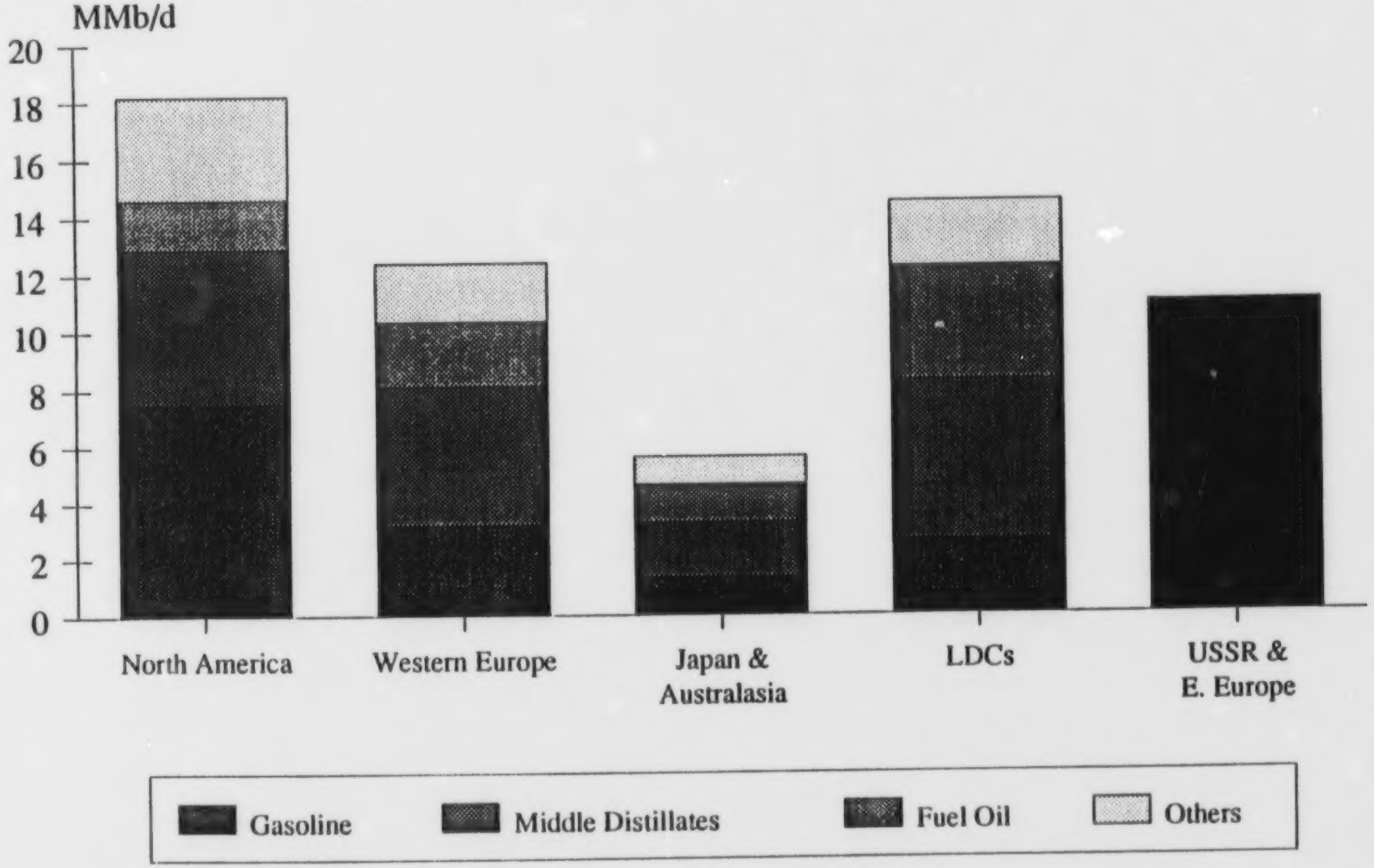
Product Composition
1989 vs. 1979



SOURCE: BP Statistical Review, CERI.

FIGURE 4

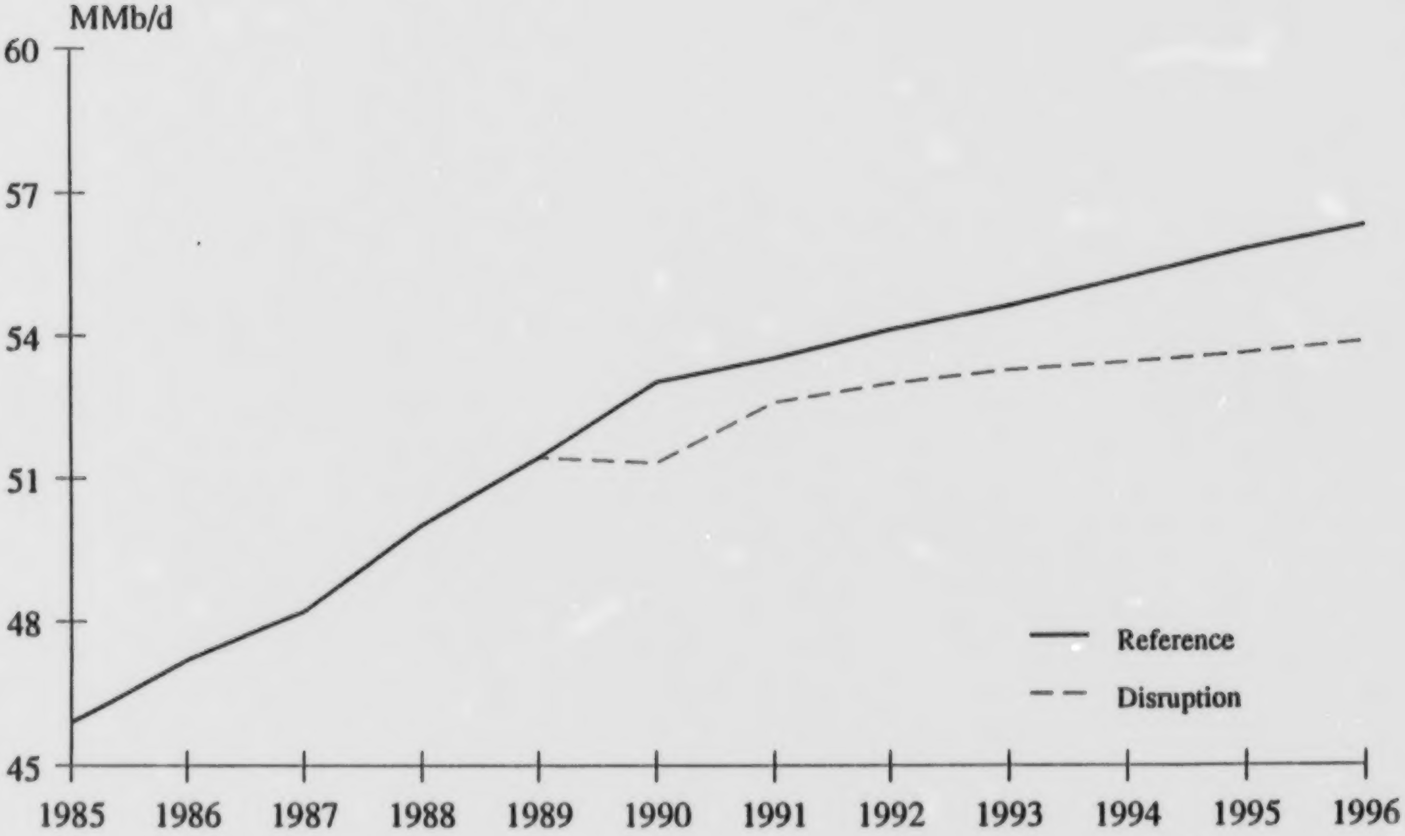
Demand by Product by Region
1989



SOURCE: BP Statistical Review, CERI.

FIGURE 5

World Crude Oil Demand
1990 - 1996



SOURCE: CERI.
Note: Excludes CPEs.

"THE OUTLOOK FOR NON-OPEC OIL PRODUCTION OVER THE LONG TERM"

Presented by

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NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
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What I would like to do is to review some of the main factors affecting the supply of non-Opec oil, and then try and form some views on the long term availability of non-Opec supplies. For the purposes of this talk, non-Opec oil will constitute world oil production (including condensates) excluding production from the present 13 members of Opec and production from what we have hitherto called the centrally planned economies (CPEs).

What are the main distinguishing features of the non-Opec oil producing countries, which currently number some 45, when it comes to oil?

. Diverse group
. Widely different sizes of reserves and production
. Medium/high cost oil
. Few oil exporters
. Some major producers are also net importers
. Wish to save foreign exchange on oil imports
. Security of supply concerns
. Mix of private/national oil companies
. Equity investment opportunites for private companies
. No overall body regulating production.

One can no doubt go on adding to this list; however the above serves to show some of the main factors affecting the attitudes of these countries when it comes to oil policy. These are highly important as they lead to different policies and reactions compared with other producers (notably Opec members) to the oil industry and to events affecting oil supply and the oil market.

(Slide 1) Non-Opec oil production has increased progressively for many decades - in North America until the early 1970s, then from other areas such as the North Sea. Non-Opec production rose from 7 mb/d in 1950 to 10 mb/d in 1960, 16 in 1970, 20 in 1980 and to 26 today. However, demand initially grew faster, and production from the present 13 members of Opec rose from 3 mb/d in 1950 to 9 in 1960, 24 in 1970, peaking at over 31 in the 'oil crisis' years of the early and late 70s. However, as demand responded to the price shocks, Opec faced the consequence of a balancing role, with production falling below 20 mb/d during the mid 80s before recovering - to 24 last year. It was only in the period 1963 to 1981 that production in Opec countries was greater than in non-Opec countries.

Non-Opec exploration and development activities were immediately stimulated by the 1973 oil price increase, although the new supply was, of course, not available for a number of years. The 1979 price rises reinforced these efforts. **(Slide 2)** Incremental non-Opec production came from established and newly-established areas (such as the North Sea), as well as new areas around the world. Oil is now produced in significant quantities in 45 non-Opec countries (excluding CPEs) - about ten more than before the 1973 oil crisis.

Essentially, once facilities are in place in non-Opec countries, that oil will be produced at full potential, consistent with good oil field practice, whether prices are high or low. Higher prices will encourage the search for and installation of more non-Opec potential: lower prices will have little impact on short term production levels but may over time erode potential. Low prices only lead to shutting in existing sources if the underlying cash cost of producing from those sources exceeds the market price. High up-front costs are not considered in this decision.

However the situation is very different for new project starts; if the economics of a project are unfavourable at expected oil prices, the project will normally be dropped, held over or reworked until the economic criteria are met. These decisions have no immediate impact on oil supply but can dramatically influence production capacity either way 3 to 5 years down the road. Project starts are thus affected by either significant rises or falls in oil price but have a delayed effect on production. The response of projects under way also exhibits significant inertia. The price falls of the mid-80s did not significantly impact non-Opec supply since projects in progress were carried through to completion and the many new projects on the stocks were apparently successfully trimmed to remain economic at the lower prevailing oil price, with hardly any apparent impact on the rate of increase of non-Opec supply.

The only significant source apparently responding rapidly to price has been indigenous U.S. supply. Production from high cost stripper oil fields of the U.S was cut back drastically in the mid-80s when the oil price collapsed; many of these fields were already at their economic limit at the pre-1985 prices.

Non-Opec Reserves

(Slide 3) Let us look at the reserve position. Since the formation of Opec in 1960, the reported oil reserves held outside the Opec nations has increased annually, almost without exception - and this despite increasing non-Opec production throughout the period. Indeed this improving trend is true of almost every region, the major exception being North America having by now largely exhausted its low cost reserves.

It has often been said that non-Opec reserves are of high cost oil; while this may be true in some cases, as in the U.S. "lower 48", the "proven" non-Opec reserves recorded in this illustration are essentially economic under current (pre-crisis) price expectations (since they are classified as "proven") and are almost certainly economic at $20/bbl, with sources such as Mexico and the North Sea for the most part economic at even lower prices. **(Slide 4)** Most of these "proven" reserves fall in "Conventional" and "Frontier" areas.

Under what conditions could these new reserves be developed? Price, particularly sustained price, is the key driving mechanism, and we will look at this later. There are however two other important factors which have contributed to both increasing non-Opec supply and insulating this supply from downward price shocks. These are the progressive reduction in technical costs for field development and the preparedness of Governments to adapt tax regimes.

Technology Effect

While oil prices were rising, development of technology was geared more towards accessing progressively more difficult reserves and producing more from increasingly difficult reservoirs. Absolute cost was less of a consideration in many areas than speed of development and we experienced an era of 'technology at almost any price'. This trend changed in the early 80s with an increasing awareness of the vulnerability of oil prices. R & D was then redirected towards 'doing what we know what to do, better and cheaper' and some very significant savings were achieved. **(Slide 5)** This example of the substructure costs for a typical North Sea development is only one of many. Throughout the industry innovative approaches brought development costs tumbling down, without jeopardising safety or reliability.

(Slide 6) This next slide illustrates some of the other developments of recent years which have and will continue to push down technical costs for field discovery and development. **(Slide 7)** Oil companies like Shell have not been slow to see the potential of these developments.

Tax Regimes

In the mean-time as the oil price fell, many governments in Non-Opec producing countries saw the need to continue to stimulate exploration and production through reductions in levels of taxation, changes in tax treatment, and introducing other incentives. **(Slide 8)** This example shows the impact on a typical North Sea development of both reducing the technical cost and changing the tax regime, but this type of change was by no means limited to the North Sea.

Centrally Planned Economies

Before looking at what this might mean in terms of long term non-Opec production, I will briefly address the difficult question of CPE oil, about which little was known until recently and what we know has still not been fully integrated into the world supply picture. **(Slide 9)** Production levels have increased 5-fold over the past 30 years. **(Slide 10)** Estimates of reserves have increased similarly. However, in recent years these have tailed off and, we are told, production no longer keeps pace with rising requirements within the CPEs themselves. Net exports, which ran around 2mb/d for many years, are now under pressure both from problems of production decline in existing fields, lack of investment in new fields, and increasing domestic demand. The conflicting requirements of hard-currency earnings, increasing internal demand (offset to some extent by a high potential for energy saving) and uncertainty over the pace of future developments all add to the uncertainty surrounding the future level of net exports from the CPEs.

Non-Opec Production Levels

Having set the scene, what can we say about future levels of non-Opec production? Today this is around 26 mb/d. Historically, forecasts of non-Opec production have tended to tail down in the later years of the forecast; history has shown that, so far, these declines have not materialised and that there has been a fairly consistent tendency to underestimate the size and longevity of non-Opec production.

What can we say today about the likely trend? To say anything means taking some view on price trends. This requires an analysis and understanding of the factors which determine demand for oil: increasing world energy demand, spurred by economic growth and increasing population, offset by increased energy efficiency, conservation and fuel switching (particularly to gas) prompted in part by environmental concerns. Similarly one would need to consider such things as the economic and geopolitical environment, the probability and consequences of supply disruptions, technological advances and Opec members' likely behaviour. One would also have to examine and take a view on the interrelationships and feedback mechanisms between all these factors. These are all things which we know from experience it is not possible to predict accurately; it is for this reason that we in Shell prefer to use scenarios of possible futures as a means of helping us to plan, and to look at non-Opec production in one scenario and then in another. However, rather than do this here, I would like to take an alternative and quicker approach and look at how the availability of non-Opec supply may vary against certain oil price assumptions. One can then situate possible production levels based on whatever scenario one wants to use for possible price levels.

To generate such projections, we require a good insight into oil reserves available world-wide, the current technical cost to develop those reserves today and an insight into the likely (progressive) reduction of that technical cost in the future. This also means taking a view on new developments in the areas of safety and environment and possible changes in government regulation.

For our projections we have applied our own judgement to the potential technical costs/bbl of various tranches comprising the total reserves base, which was in turn gathered from various public and private sources. We have also projected a reduction in these technical costs, for any particular reserves within the total reserves base, of some 33% from 1989 to 2010. This figure may seem very conservative when compared with the improvement over the last decade (circa 40% in some projects) but it seems prudent to assume the law of diminishing returns applies here too.

(Slide 11) The result shows that $20/bbl (1990 real terms) is sufficient to virtually maintain the non-Opec supply throughout the period. $15/bbl shows a gradual decline, whereas $10/bbl limits further developments to only a few places worldwide.

The major new contributing element that enables non-Opec supply to hold up so well at $20/bbl post the year 2000 is that oil won from 'enhanced oil recovery' projects (EOR) is likely to be economic at this level soon after the turn of the century. Currently the best projects are probably economic at some $25/bbl, but Shell and others are developing the technology which could reduce that significantly over a 15 year time period.

EOR techniques could improve recovery factors conservatively by as much as 5%, which could mean as much as 100 billion barrels of additional oil from non-Opec sources alone. And tar sands and other "syncrudes" would add much more than this.

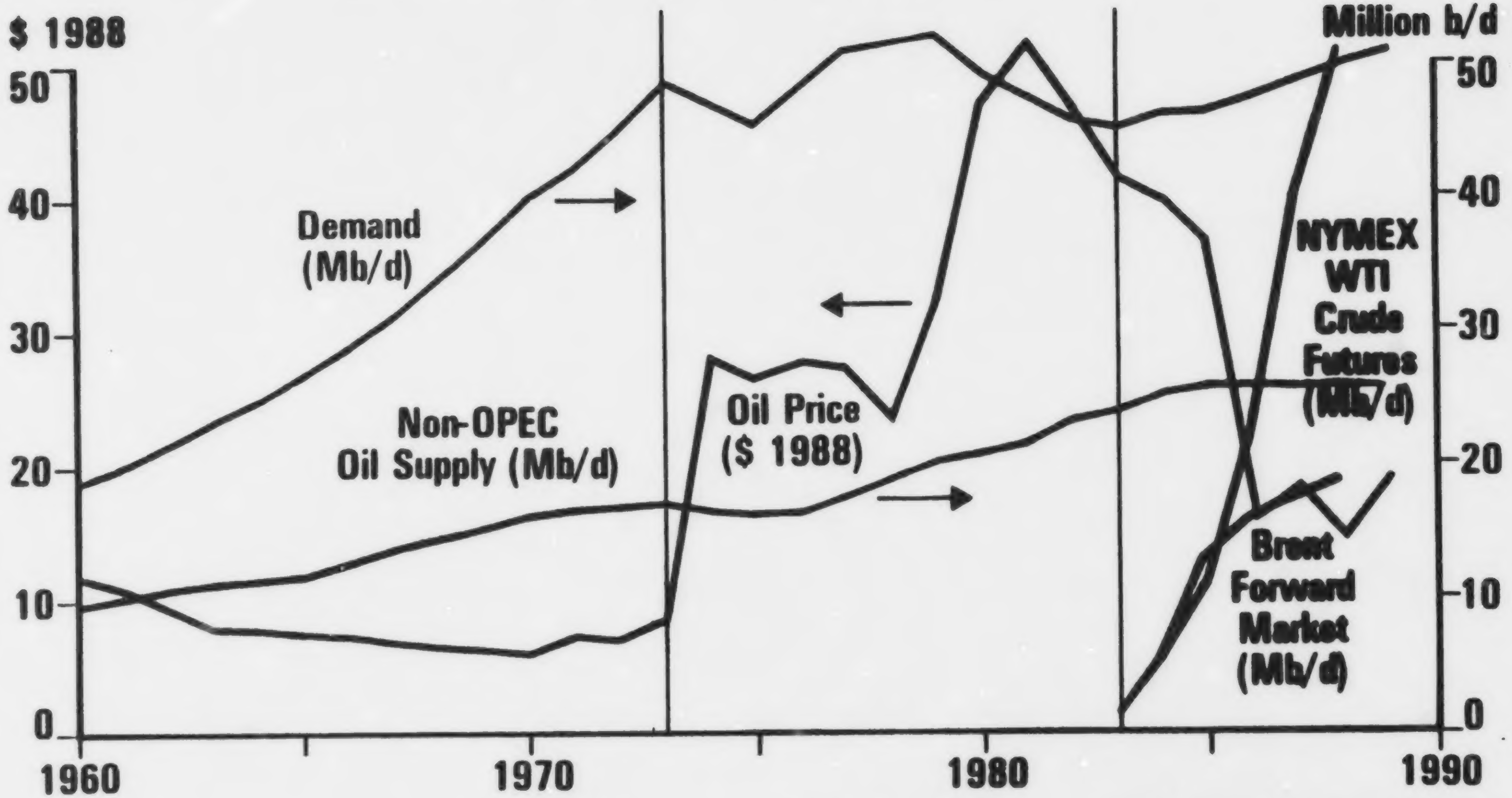
(Slide 4) Referring back to the "Hydrocarbon Opportunities", one could conjecture that it is the tranche of EOR (Improved Recovery) which may also set the price ceiling for oil , since very large volumes could eventually be made available with only a moderate technological break-through required.

Against this background, and whilst accepting that it is most unlikely that in practice oil prices will remain conveniently in line with any given price projection level, we believe that a 1990 real terms oil price averaging over time around $20/bbl should be sufficient to allow non-Opec supply to be maintained at around 26 mb/d for many years to come. Even at lower prices than this, one could expect it to hold up above the 20 mb/d level until the turn of the century. Quite apart from this price aspect, there are a number of other important considerations, such as security of supply and desire to save on foreign exchange, which will also help to sustain non-Opec availability.

AW/LS/07.09.90

Slide 1

THREE REGIMES OF THE OIL INDUSTRY



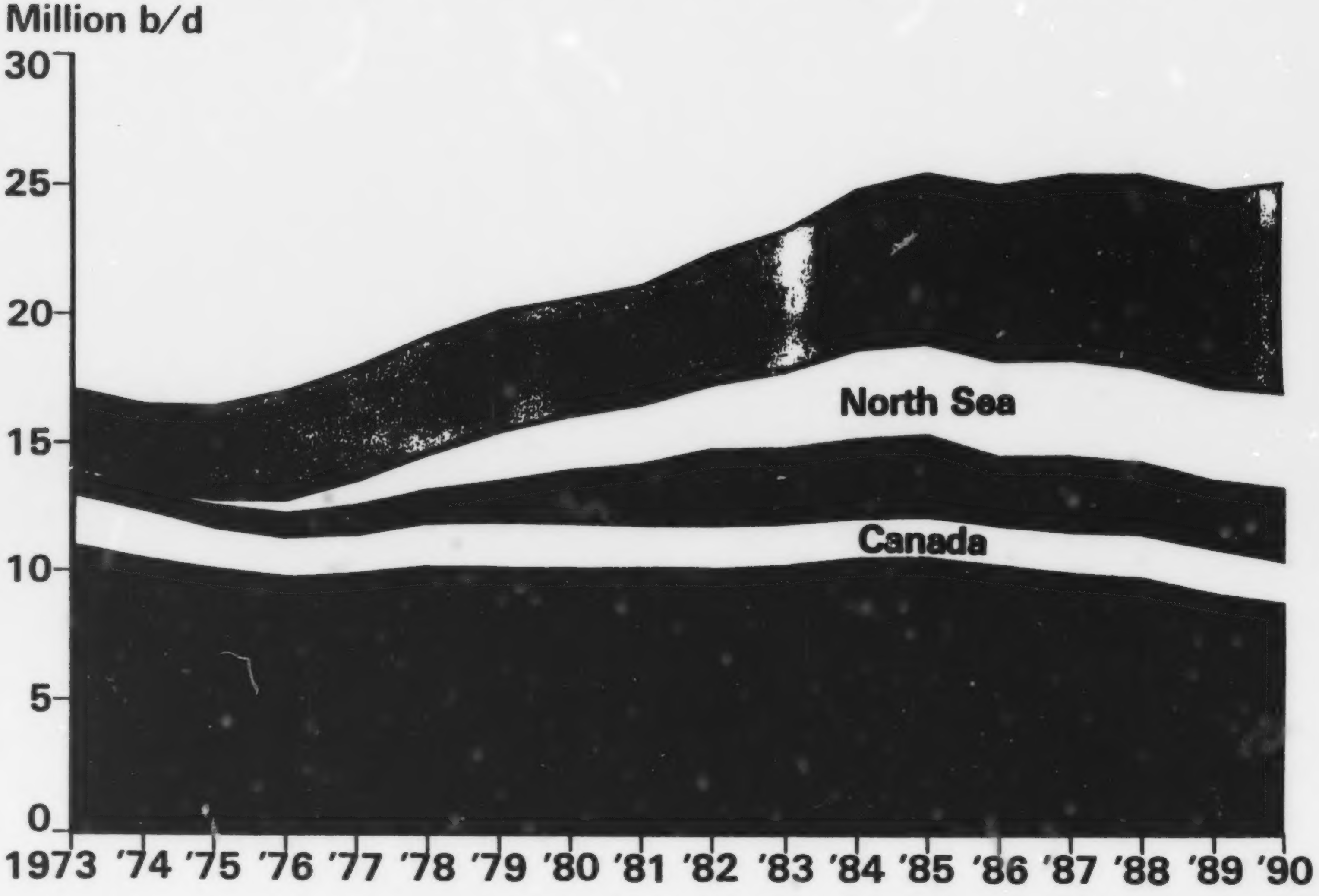
	CONCESSION SYSTEM	OPEC CONTROL	COMMODITY MARKETS
Vert. integration	strong } Majors	informal, weakening	very weak
Horiz. integration	strong } Majors	strong	weak
Price setting	Posted Price	Marker Price	Spot Market

Group Planning

PL/13 August 1990

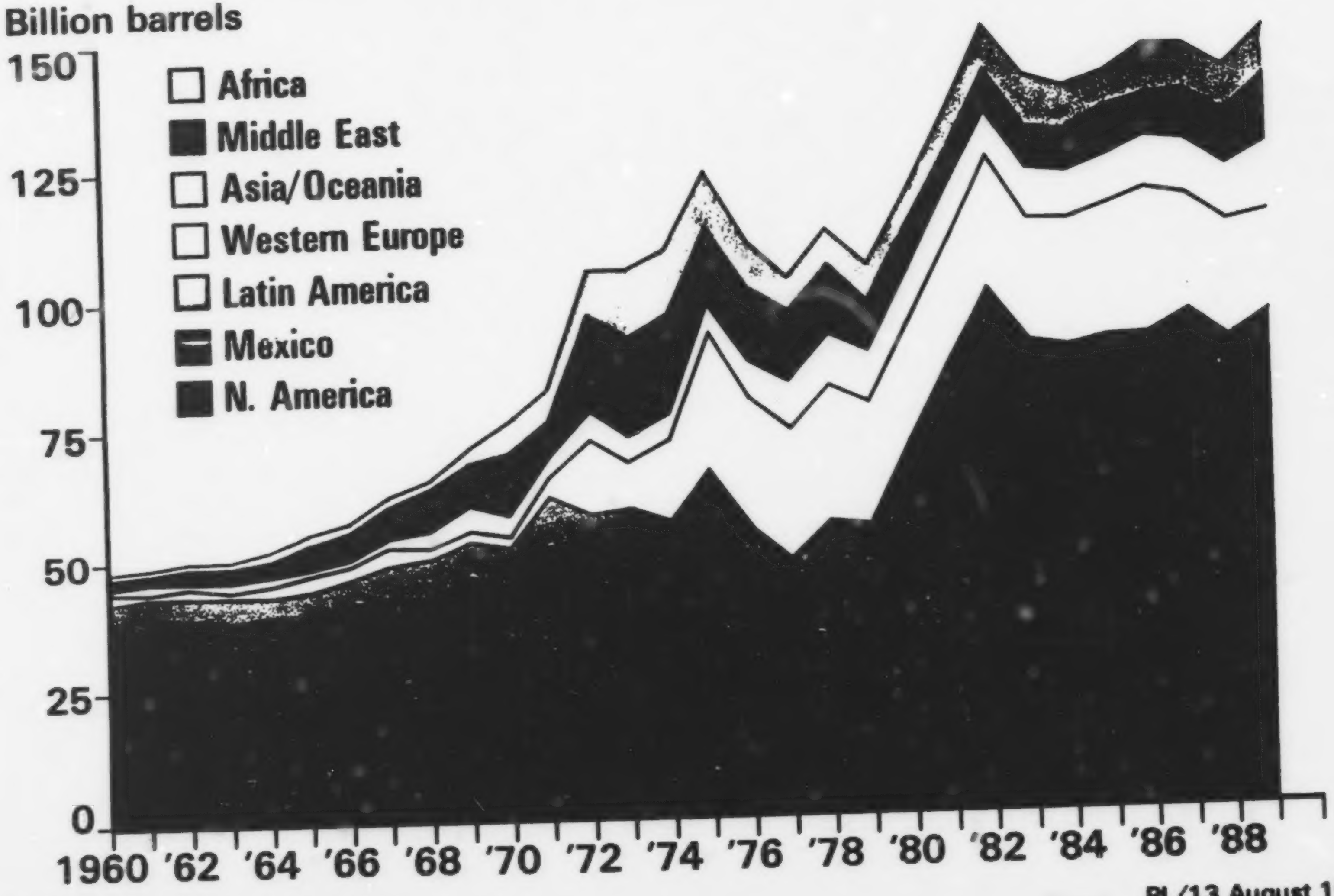
NON-OPEC OIL SUPPLY

(excluding USSR, Eastern Europe and China)



PL/13 August 1990

NON-OPEC* PROVEN OIL RESERVE ESTIMATES



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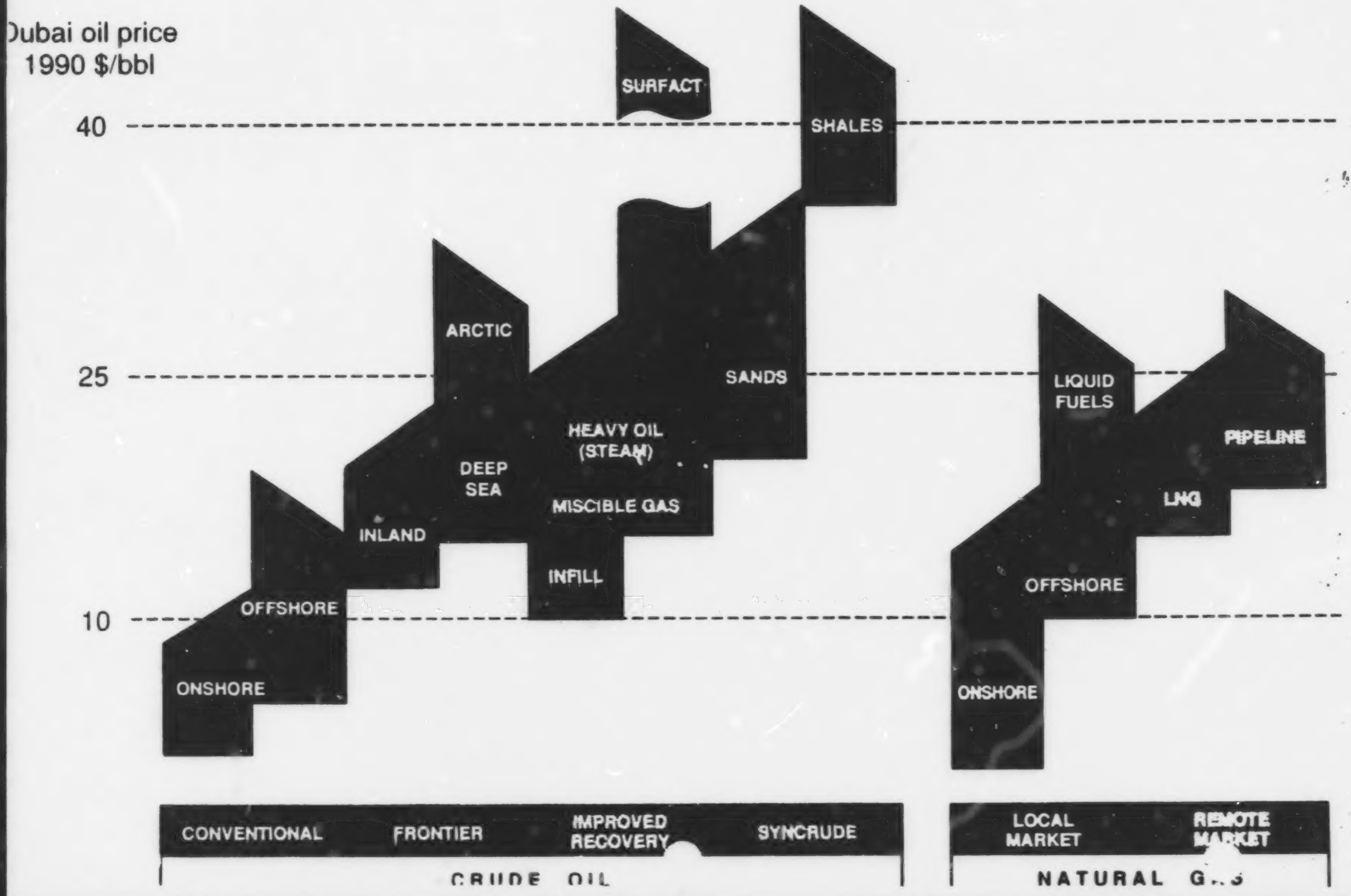
* Excluding Communist Areas

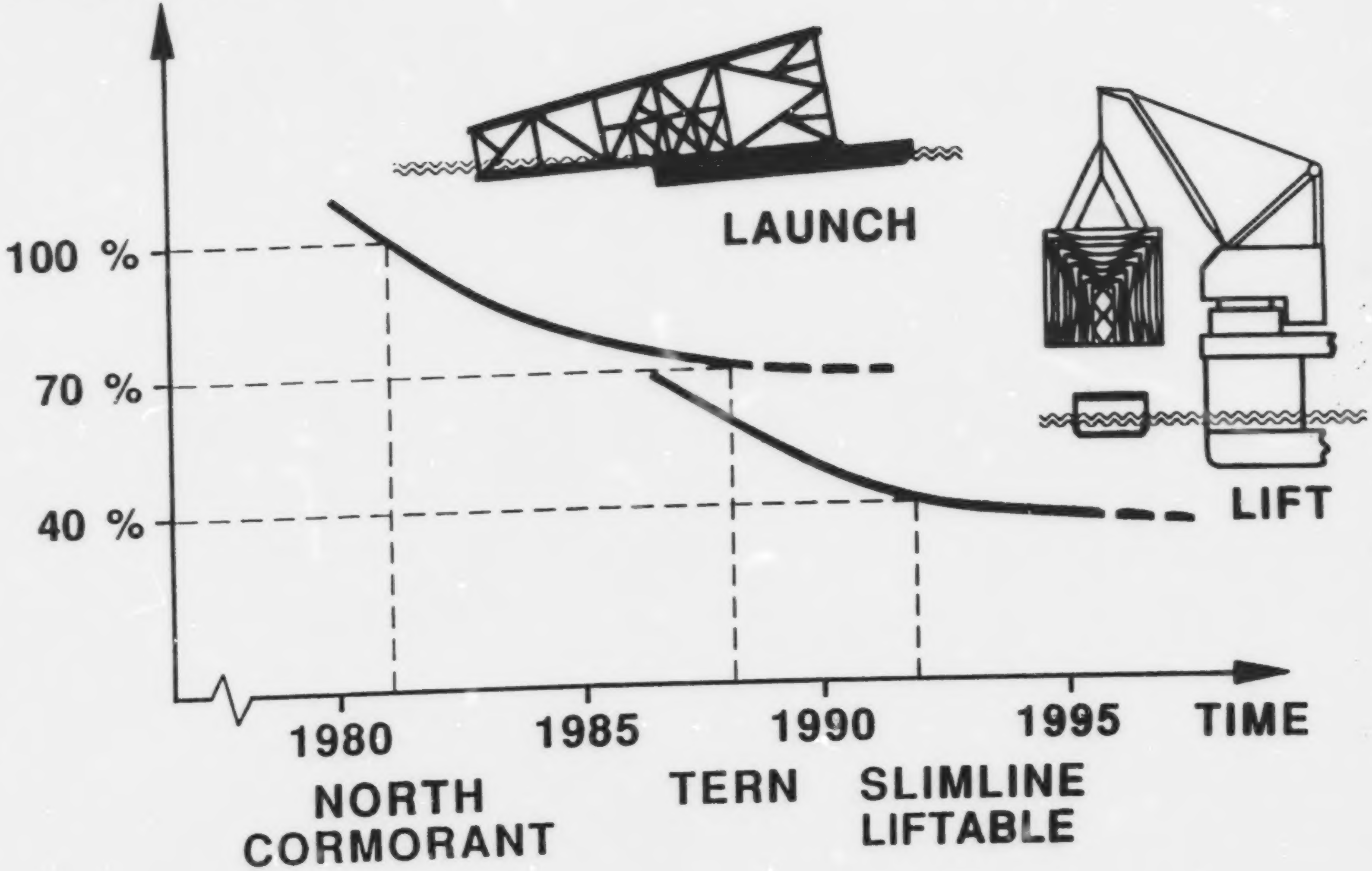
lide 4

H.C. OPPORTUNITIES - CURRENT TECHNOLOGY



Slide 5

Relative costs of Northern North Sea Substructures



TECHNOLOGICAL SCENARIO

(Examples)

- Exploration

  Higher success ratio from improved basin modelling and seismic

- Field development

  Optimum development from advanced reservoir modelling
  Increased recovery from horizontal wells and fracturing

- Drilling

  Rig automation and measurement while drilling
  Slim-hole rigs

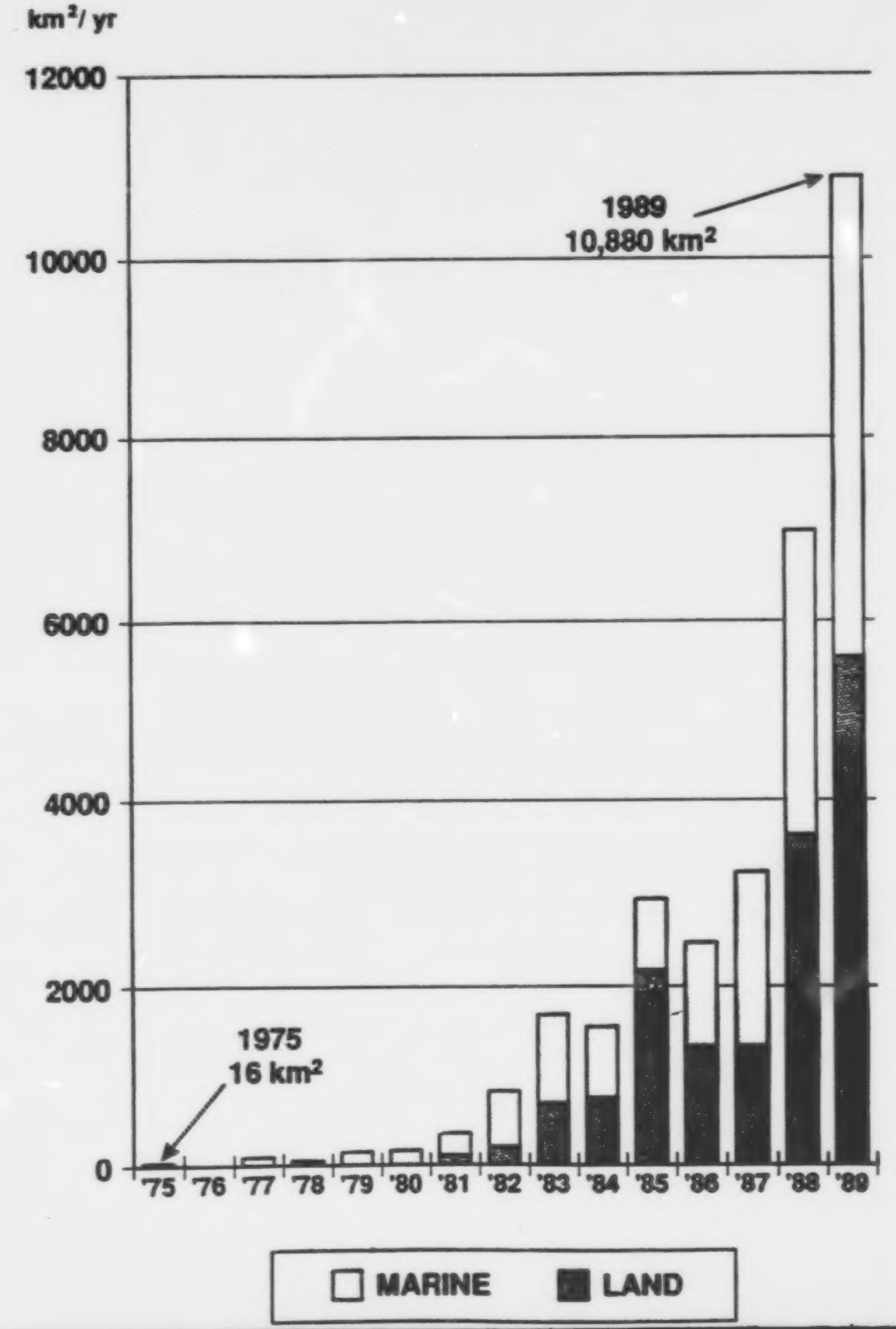
- Offshore engineering

  Simpler platform and subsea design
  More satellite developments

- Management

  Effective field application of new technology
  Joint industry projects

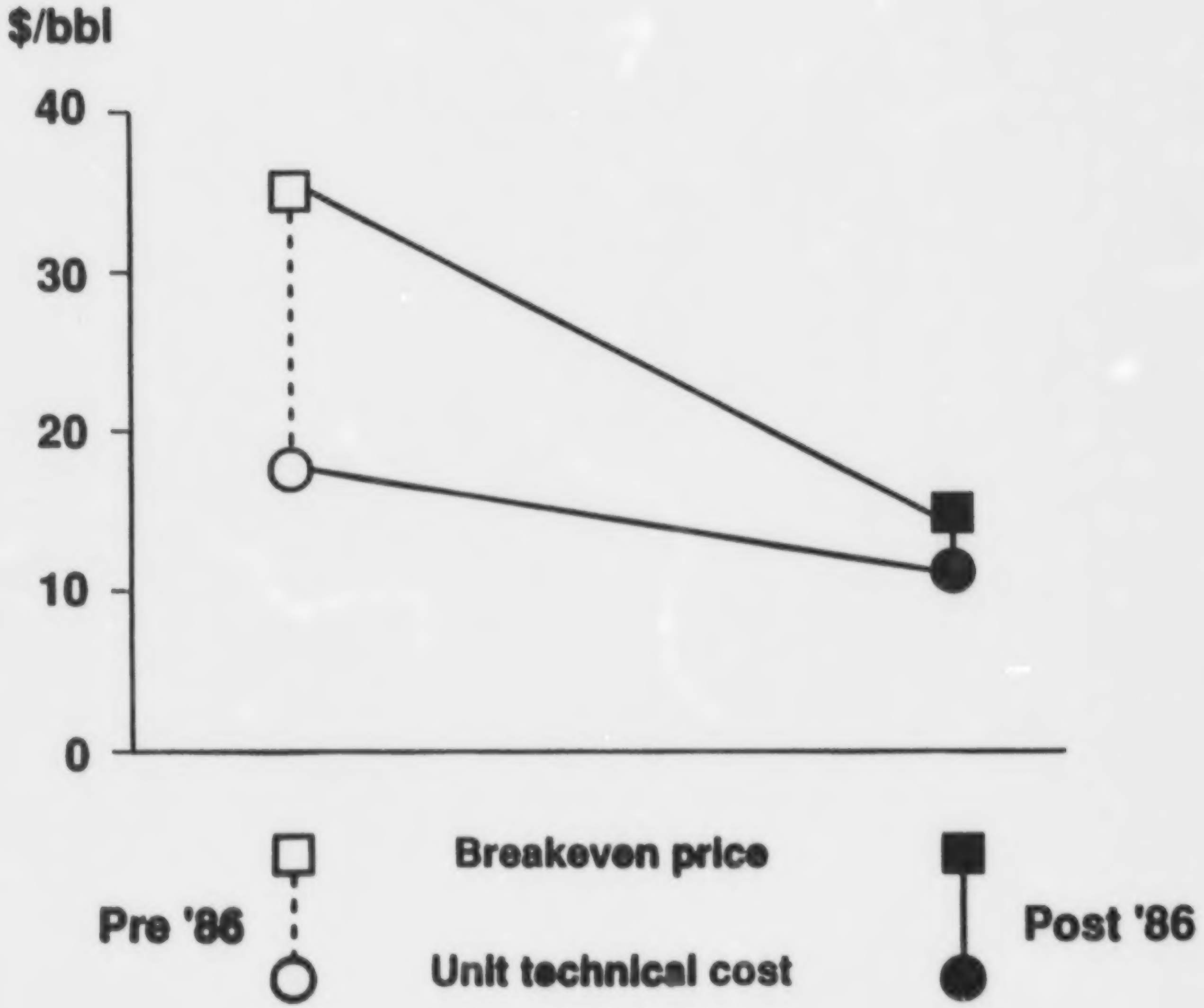
THE INCREASING APPLICATION OF 3D SEISMIC IN SHELL, OUTSIDE N. AMERICA



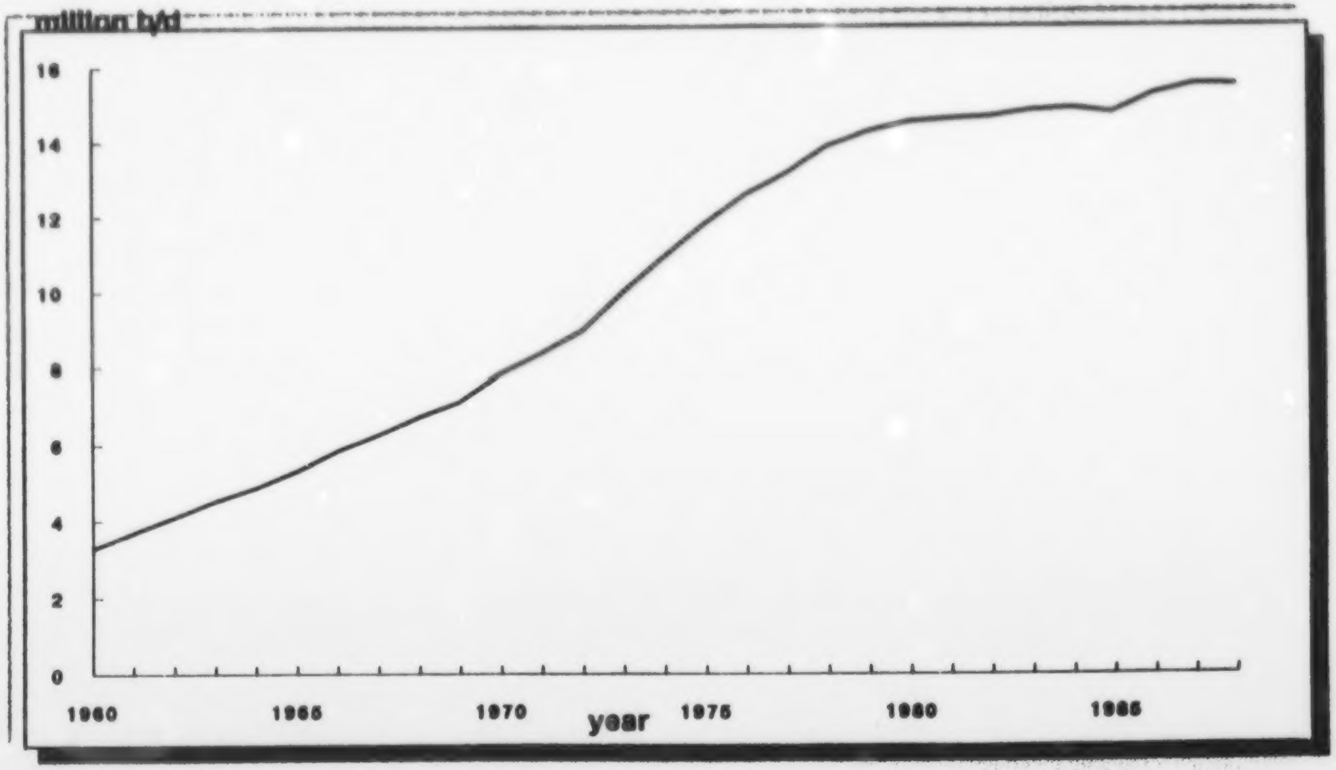
1989
10,880 km²

1975
16 km²

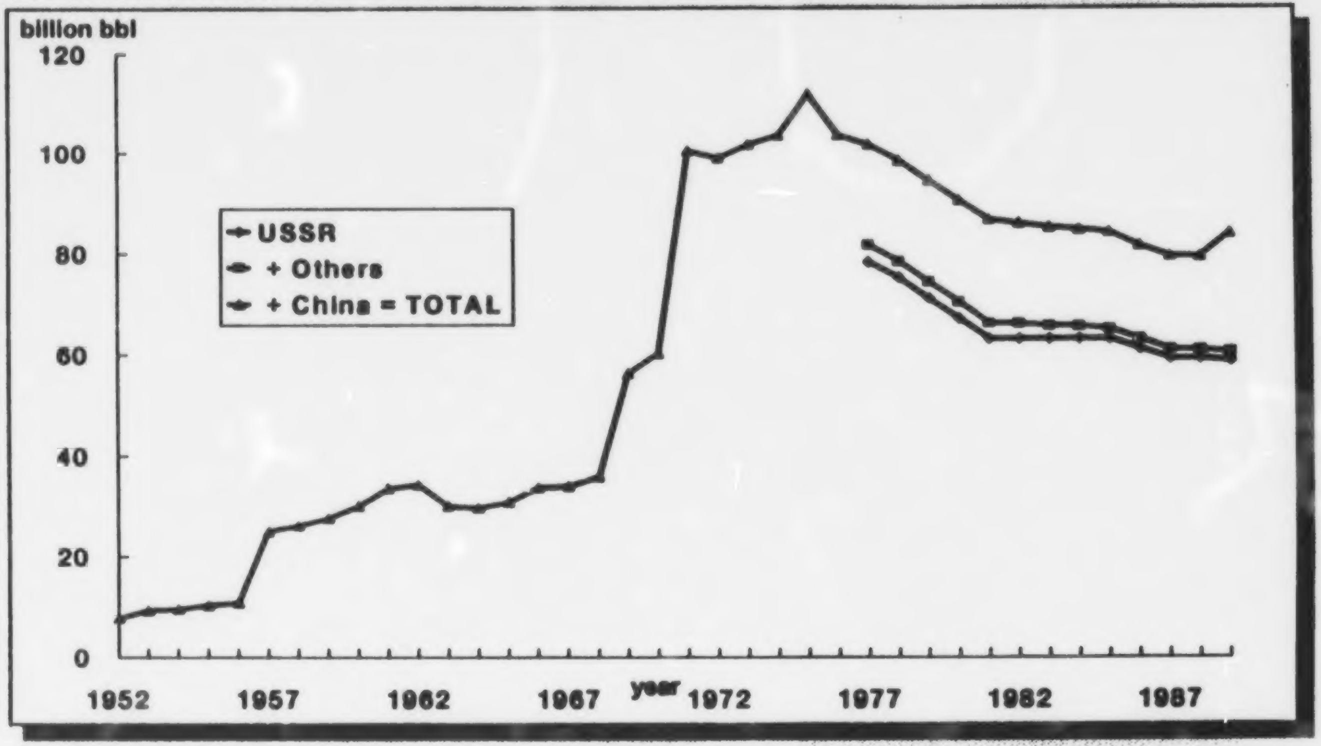
INDUSTRY/GOVERNMENT ADJUSTMENT POST 1986



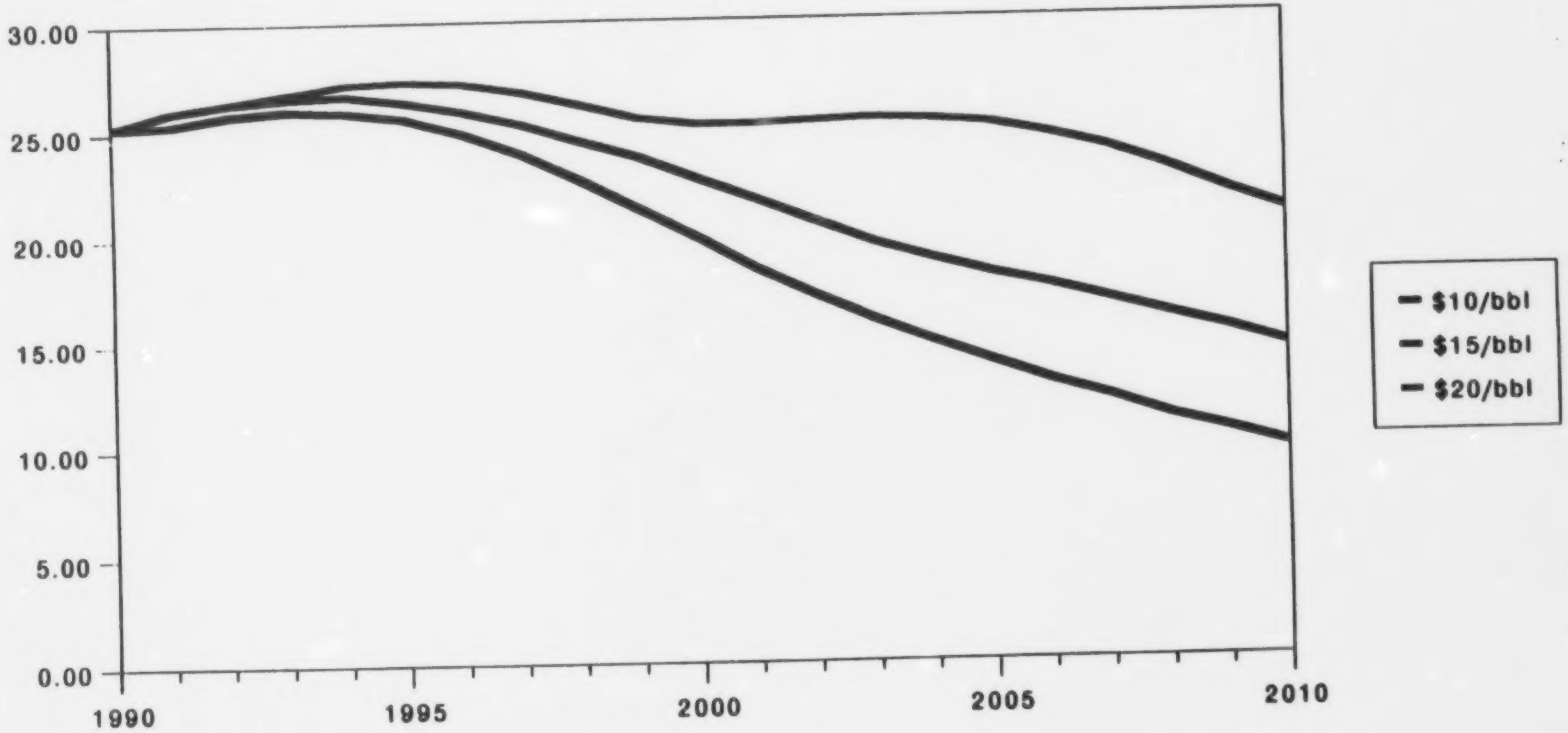
Communist Area Oil Production



Reserves Estimates for Communist Area



Non-OPEC oil supply potential in mbd, real terms 1990 $



The Persian Gulf Conflict and World Oil Markets

Dr. Cyrus H. Tahmassebi
Chief Economist and Director of Market Research
Ashland Oil, Inc.

Ninth CERI International Oil & Gas Markets Conference
September 23-25, 1990
Calgary, Canada

A crisis with unprecedented magnitude of uncertainty and potential impact

The Persian Gulf crisis has once again thrown the world oil markets into a chaos, creating a great uncertainty of unprecedented magnitude. It has the potential of impacting the world oil and energy markets profoundly both short-term and in the long run.

Crisis scenarios and market outlook

- Short-term (present to March/April 1991)
- Medium-term (1991-1993)
- Long-term (1993-2010)

Crisis scenarios and market outlook

(Continued)

Short-term (present to March/April 1991)

- Peaceful resolution (less likely)
  - ✓ Status quo ante
  - ✓ Change in government
  - ✓ Change in borders

Crisis scenarios and market outlook

(Continued)

Short-term (present to March/April 1991)

- Military confrontation (highly probable)
  - ✓ Little or no damage to the oil installations
  - ✓ Moderate damage to the oil installations
  - ✓ Extensive damage to the oil installations but no spillovers
  - ✓ $45/bbl for WTI as a trigger point for SPR withdrawal

Crisis scenarios and market outlook

(Continued)

Short-term (present to March/April 1991)

- Market ramifications
  - ✓ Continued uncertainty
  - ✓ Markets overreacting to events/statements/rumors
  - ✓ Very tight market with possibility of severe shortages
  - ✓ Price range for WTI: $20/bbl to $45/bbl

Crisis scenarios and market outlook

(Continued)

Medium-term (1991-1993)

- Crisis ended (highly probable)
  - ✓ Little or no damages to the oil installations
  - ✓ Moderate damage
  - ✓ Extensive damages to the oil installations, but no spillovers

Crisis scenarios and market outlook

(Continued)

Medium-term (1991-1993)

- Stalemate (less likely)
  - ✓ Crisis not ended by March/April 1991
  - ✓ Probability of a military confrontation declines and the embargo gradually loses its effectiveness

Crisis scenarios and market outlook

(Continued)

Medium-term (1991-1993)

- Market ramifications
  - ✓ Chances are that there ***will*** be some damages to the oil installations
  - ✓ Assuming these damages will be limited to Kuwait and Iraq, additional products from other sources will be sufficient to make up for the shortfall. By late 1991, markets will be in balance.
  - ✓ Price range for WTI: $20/bbl to $25/bbl

Crisis scenarios and market outlook

(Continued)

Long-term (1993-2010)

- Both the producers and consumers faced enormous challenges concerning their long-term policies even before the Persian Gulf crisis. The gulf crisis has added new dimensions to the issues to be dealt with.

Long-term issues facing the consuming countries

- Dependency on foreign oil
  - National security concerns
  - Affordability
  - Availability of supply
- Taxation policy to curb consumption and encourage indigenous sources of supply
- Promotion of alternative sources of energy, energy efficiency, and new technologies

Long-term issues facing the consuming countries

(Continued)

- Environmental issues and tradeoff between those issues and national security
- Cooperation and dialogue with OPEC

Long-term issues facing the producing countries

- How to keep OPEC together
- Accommodation of the Iraqi and Kuwaiti re-entrance into the world oil markets
- Restoration of confidence in OPEC as a secure source of supply
- Long-term pricing policy to keep oil competitive vs. pressing financial needs

Long-term issues facing the producing countries

(Continued)

- Uncertainty and risks in generating new production capacity given the growing environmental and national security concerns in the major consuming markets
- More efficient use of the oil revenues
  - ✓ Military vs. economy
  - ✓ Prioritization and allocation

Long-term price outlook

- Total world proven reserves now stand at a level higher than at any time in the history of the oil industry
- Political decisions, production control, etc. are eventually overwhelmed by the market forces in the long run
- Long-term world oil prices are likely to fall below the pre-crisis trend line

Long-term price outlook

(Continued)

- Energy (oil, gas, coal alternatives) produced indigenously in the consuming countries are likely to enjoy some form of government support, creating certain amount of disparity between domestic and imported prices
- Slower economic growth and new conservation policies will dampen demand growth
- Long-term real price range: $15/bbl to $20/bbl for Middle Eastern crudes

ENERGY AND THE ENVIRONMENT: CANADIAN POLICY DIRECTION

NOTES FOR A SPEECH BY

BRIAN EMMETT

ENVIRONMENT CANADA

TO

THE NINTH CERI INTERNATIONAL OIL AND GAS MARKETS CONFERENCE

CALGARY, ALBERTA

SEPTEMBER 24, 1990

ENERGY AND THE ENVIRONMENT: CANADIAN POLICY DIRECTION

INTRODUCTION

IT IS A PLEASURE TO BE HERE IN CALGARY TO ADDRESS THE NINTH CERI INTERNATIONAL OIL AND GAS MARKETS CONFERENCE.

I HAVE BEEN ASKED TO SPEAK ON CANADIAN POLICY ON ENERGY AND THE ENVIRONMENT. I WOULD PROPOSE TO APPROACH THIS DAUNTING TASK IN THREE STEPS. FIRST, I WOULD LIKE TO SAY A FEW WORDS ABOUT THE CONTEXT IN WHICH WE ARE WORKING TO DEVELOP ENVIRONMENTAL POLICY. SECOND, I WOULD LIKE TO TALK ABOUT THE GREEN PLAN ITSELF AND THE OVERALL SHAPE IT IS ASSUMING. FINALLY, I WOULD PROPOSE TO DISCUSS THE DIFFICULTIES POSED TO POLICY-MAKERS BY ENERGY AND THE ENVIRONMENT, MAKING SPECIFIC REFERENCE TO THE ISSUE OF CLIMATE CHANGE AS AN EXAMPLE OF THE CHALLENGES WE FACE.

THE POLICY CONTEXT

THIS IS AN EXCITING TIME TO BE INVOLVED IN ENVIRONMENTAL POLICY. ON THE ONE HAND, CONCERN OVER THE NATURAL ENVIRONMENT IS CHANGING IN A FUNDAMENTAL WAY WHAT CITIZENS EXPECT GOVERNMENTS TO DELIVER. AT THE SAME TIME, INCREASES IN SCIENTIFIC

KNOWLEDGE AND ESPECIALLY THE TECHNOLOGY WHICH ALLOWS US TO MEASURE THE PRESENCE OF SUBSTANCES IN UNIMAGINABLY SMALL AMOUNTS ARE ALTERING OUR UNDERSTANDING OF THE NATURE AND EXTENT OF ENVIRONMENTAL PROBLEMS - AND CHANGING OUR UNDERSTANDING OF WHAT WILL BE NEEDED IF WE ARE TO ADDRESS THESE PROBLEMS EFFECTIVELY.

THERE HAS ALSO BEEN A SIGNIFICANT CHANGE IN THINKING AND EXPECTATIONS ABOUT THE RELATIONSHIP BETWEEN THE ENVIRONMENT AND ECONOMIC GROWTH. IN THE 1970'S, WE SPOKE OF LIMITS TO GROWTH - A POLICY RESPONSE TO FORECAST RESOURCE SHORTAGES AND ENVIRONMENTAL DETERIORATION WHICH INVOLVED REDUCING OUR EXPECTATIONS OF WHAT THE ECONOMY COULD PROVIDE. ECONOMIC DEVELOPMENT AND HIGH LEVELS OF ENVIRONMENTAL QUALITY WERE PERCEIVED AS MUTUALLY INCOMPATIBLE. UNDERSTANDABLY, THIS BASIC MESSAGE CAUSED SOME CONCERN AMONGST THE LARGE NUMBERS OF POOR PEOPLE IN THE WORLD WHO DESPERATELY HOPED TO IMPROVE THEIR STANDARD OF LIVING.

TODAY, OUR CHARACTERIZATION OF THE ENVIRONMENT/ECONOMY PROBLEM IS DIFFERENT, INFLUENCED IN LARGE BY THE 1987 REPORT OF THE WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT. THE COMMISSION NOTED THAT PRESSURES ON THE WORLD'S ENVIRONMENTAL

RESOURCES WERE INCREASING. AT THE SAME TIME, THE REPORT CLEARLY RECOGNIZED THE PRESSING NEED FOR THE LESS DEVELOPED REGIONS OF THE WORLD TO ACHIEVE A STANDARD OF LIVING CLOSER TO OUR OWN.

THE BRUNDTLAND REPORT CONCLUDED THAT A FIVE TO TEN FOLD EXPANSION OF MANUFACTURING OUTPUT WOULD BE NECESSARY IF DEVELOPING COUNTRIES WERE TO ACHIEVE ACCEPTABLE INCREASES IN THEIR STANDARDS OF LIVING BY 2050. MOST SIGNIFICANTLY, THE REPORT ALSO CONCLUDED THAT SUCH AN INCREASE IS POSSIBLE, WHILE RESPECTING ENVIRONMENTAL LIMITS, IF WE EMBRACE THE CONCEPT OF SUSTAINABLE DEVELOPMENT. THUS ECONOMIC ACTIVITY AND ENVIRONMENTAL QUALITY ARE PERCEIVED AS REINFORCING, NOT CONTRADICTORY, AS LONG AS WE ARE WILLING TO RETHINK OUR RELATIONSHIP TO NATURE.

THIS BRINGS US TO THE NUB OF THE QUESTION WE ARE ADDRESSING TODAY. A SECURE SUPPLY OF COMPETITIVELY PRICED ENERGY IS GENERALLY SEEN AS ONE OF THE PRECONDITIONS FOR ECONOMIC PROSPERITY. IN OUR OWN COUNTRY, ENERGY IS A PARTICULARLY IMPORTANT ELEMENT OF OUR RELATIVELY RESOURCE INTENSIVE ECONOMY. IT HAS BEEN AND CONTINUES TO BE A KEY INGREDIENT TO OUR ECONOMIC PROSPERITY.

YET ENERGY IS ALSO PROMINENTLY LINKED TO A WIDE RANGE OF ENVIRONMENT PROBLEMS - FROM GLOBAL WARMING, TO SMOG, TO RADIOACTIVE WASTE DISPOSAL AND ACID RAIN AMONGST OTHER ENVIRONMENTAL PHENOMENA. IT FOLLOWS IF SUSTAINABLE ECONOMIC DEVELOPMENT IS TO BE MORE THAN A HOPEFUL BUT EMPTY PHRASE, ENERGY PRODUCTION AND CONSUMPTION MUST BE RECONCILED WITH ENVIRONMENTAL OBJECTIVES.

ENVIRONMENTAL POLICY - A BETTER ENVIRONMENT

AS MOST OF YOU ARE AWARE, THE FEDERAL GOVERNMENT IS DEVELOPING AN ENVIRONMENTAL ACTION PLAN FOR CANADA - THE GREEN PLAN. THIS SPRING WE ENGAGED IN AN EXTENSIVE CONSULTATIONS PROCESS WITH CANADIANS FROM ALL SEGMENTS OF SOCIETY. WE STARTED THE CONSULTATIONS PROCESS WITH A PAPER ENTITLED A FRAMEWORK FOR DISCUSSION ON THE ENVIRONMENT. THE PAPER OUTLINED THE GOVERNMENT'S PROPOSED ENVIRONMENTAL POLICY FRAMEWORK, AND SET OUT POSSIBLE MEASURES TO DEAL WITH SPECIFIC ENVIRONMENTAL ISSUES. WE ASKED CANADIANS TO GIVE US THEIR VIEWS ON THE GOVERNMENT'S SUGGESTED APPROACH, AND TO TELL US WHETHER THEY AGREED WITH OUR PROPOSED PRIORITIES.

IN AUGUST, WE RELEASED A REPORT ON WHAT WE HAD HEARD, AND HELD A CONSULTATIONS WRAP-UP WHICH INVOLVED SENIOR REPRESENTATIVES OF THE BUSINESS SECTOR, ENVIRONMENTAL GROUPS, THE HEALTH COMMUNITY, AND OTHERS.

A NUMBER OF CLEAR MESSAGES CAME OUT OF THE CONSULTATIONS PROCESS:

- DESPITE THE EMERGENCE OF A NUMBER OF MAJOR ISSUES COMPETING FOR ATTENTION - THE CONSTITUTION, NATIVE AFFAIRS AND INTERNATIONAL DEVELOPMENTS, FOR EXAMPLE, - CANADIANS REMAIN DEEPLY CONCERNED ABOUT THE ENVIRONMENT AND FEEL ENVIRONMENTAL QUALITY IS DETERIORATING.

- CANADIANS ARE LOOKING TO GOVERNMENTS FOR ACTION AND LEADERSHIP. WHILE THE SUBSTANTIAL RESPONSIBILITY FOR THE ENVIRONMENT RESTS WITH THE PROVINCES UNDER THE CONSTITUTION, CANADIANS LOOK PRIMARILY TO THE FEDERAL GOVERNMENT FOR LEADERSHIP.

- AT THE SAME TIME, PEOPLE RECOGNIZE THAT INDIVIDUALS HAVE A KEY ROLE TO PLAY AND ARE OPTIMISTIC ABOUT OUR ABILITY TO SOLVE OUR ENVIRONMENTAL PROBLEMS IF WE WORK TOGETHER.

- RATHER THAN FOCUSING ON SINGLE ISSUE AREAS, CANADIANS SEEK ACTION ON A BROAD RANGE OF ISSUES FROM GLOBAL WARMING TO TOXICS TO WASTE MANAGEMENT, PARKS AND WILDLIFE.

- CONSISTENT WITH THIS, PEOPLE SET PRIORITIES ON A HORIZONTAL BASIS - MEANING THOSE ACTIVITIES WHICH ARE LINKED TO THE SOLUTION OF A NUMBER OF ENVIRONMENTAL PROBLEMS. FOR EXAMPLE, THERE WAS A GENERAL EMPHASIS OR MORE AND BETTER SCIENCE, INFORMATION AND EDUCATION.

WHAT CANADIANS WERE TELLING US IS CONSISTENT WITH WHAT WE INCREASINGLY UNDERSTAND ABOUT THE NATURE OF THE ENVIRONMENT - THAT IS, AIR, WATER AND LAND ARE NOT SEPARATE ENTITIES, BUT FORM INTEGRATED ECOSYSTEMS WHICH REQUIRE SYSTEMATIC ACTION ACROSS A BROAD FRONT.

THE GREEN PLAN

THE GREEN PLAN WILL REFLECT BOTH WHAT WE HAVE HEARD FROM CANADIANS AND THE EVOLUTION OF OUR OWN POLICY THINKING. AS THE GREEN PLAN IS CURRENTLY UNDER CONSIDERATION BY MINISTERS, IT IS NOT POSSIBLE TO BE EXCESSIVELY DEFINITIVE ABOUT ITS DETAILS. HOWEVER, I CAN INDULGE IN SOME INFORMED SPECULATION ON WHAT GENERAL FORM IT IS LIKELY TO TAKE.

FIRST, I EXPECT THE GREEN PLAN WILL TAKE A COMPREHENSIVE APPROACH. IT WILL BE A CO-ORDINATED PACKAGE OF ACTION ACROSS A BROAD RANGE OF ENVIRONMENTAL ISSUES FROM CLIMATE CHANGE TO PARKS AND WILDLIFE. THIS CORRESPONDS TO WHAT CANADIANS WANT. EQUALLY IMPORTANTLY, IT CORRESPONDS TO WHAT WE KNOW ABOUT ECOSYSTEMS AND THE LINKAGES BETWEEN THEM.

SECONDLY, I EXPECT THE GREEN PLAN WILL REFLECT THE IMPORTANCE THAT WE AND CANADIANS ATTACH TO TAKING ACTION WHICH HELPS US ADDRESS ENVIRONMENTAL ISSUES ACROSS A BROAD FRONT. FOR EXAMPLE, I EXPECT THE GREEN PLAN TO EMPHASIZE BETTER SCIENCE TO ALLOW US TO UNDERSTAND ENVIRONMENTAL PROBLEMS AND THEIR SOLUTIONS; BETTER INFORMATION TO ALLOW CANADIANS TO MAKE INFORMED DECISIONS AND TO HOLD GOVERNMENTS, INDUSTRY AND

THEMSELVES ACCOUNTABLE; BETTER EDUCATION LEADING TO AN ENVIRONMENTALLY LITERATE POPULATION INCREASINGLY INVOLVED IN MAKING ENVIRONMENTAL DECISIONS.

THIRD, I EXPECT THE GREEN PLAN WILL BE VERY SPECIFIC ABOUT WHAT OUR VISION OF OUR ENVIRONMENTAL FUTURE IS AND WHAT IT MEANS IN PRACTICAL TERMS. FOR EXAMPLE, WITH RESPECT TO THE ENVIRONMENT, IT MEANS:

- GLOBAL ENVRIONMENTAL SECURITY - CLIMATE CHANGE, OZONE DEPLETION AND INTERNATIONAL CITIZENSHIP;

- DELIVERING ON COMMITMENTS TO CLEAN AIR, WATER AND LAND AT HOME;

- ENSURING SUSTAINABLE RENEWABLE RESOURCE USE, FORESTS, FISHERIES AND AGRICULTURE; AND,

- PROTECTING PARKS, HISTORIC SITES AND WILDLIFE.

WITH RESPECT TO BEHAVIOUR IT MEANS:

- ENVIRONMENTAL RESPONSIBILITY THROUGH BETTER DECISION-MAKING.

WE WILL LIKELY GO BEYOND THIS AND ATTEMPT TO DESCRIBE OUR VISION IN QUANTITATIVE TERMS LAYING OUT TARGETS AND SCHEDULES WHEREVER WE CAN TO ESTABLISH A FRAMEWORK FOR ACCOUNTABILITY.

FOURTH, WE THINK IT VERY IMPORTANT TO SPECIFY THE PRINCIPLES UNDERLYING OUR ENVIRONMENTAL THINKING. IT IS THESE PRINCIPLES WHICH SERVE TO GUIDE US IN TRANSLATING OUR VISION INTO A STRUCTURE OF ACTIVITIES. THEY WILL INCLUDE RESPECT FOR NATURE; EFFICIENCY IN RESOURCE USE; AND THE RIGHT TO CONSULTATION AND SO ON.

FINALLY, THE HEART OF THE GREEN PLAN WILL BE AN ACTION PLAN WHICH DESCRIBES HOW THE FEDERAL GOVERNMENT WILL DO ITS PART TO PUT OUR PRINCIPLES INTO ACTION TO ACHIEVE OUR OVERALL VISION.

ENVIRONMENTAL POLICY - ENERGY

AS I NOTED EARLIER, A SECURE SUPPLY OF COMPETITIVELY PRICED ENERGY IS A KEY TO A DYNAMIC AND COMPETITIVE ECONOMY. BUT THE

PRODUCTION AND CONSUMPTION OF ENERGY ARE LINKED TO MANY OF OUR MOST DIFFICULT ENVIRONMENTAL PROBLEMS - CLIMATE CHANGE, ACID RAIN, SMOG, OIL SPILLS, THE MANAGEMENT OF RADIOACTIVE WASTE. ENVIRONMENTALLY SUSTAINABLE ENERGY PRODUCTION AND CONSUMPTION IS POSSIBLE. IT, THEREFORE, IS A KEY PART OF THE SOLUTION.

CLIMATE CHANGE, FOR EXAMPLE, IS ONE OF OUR MOST CHALLENGING ENVIRONMENTAL PROBLEMS. SCIENTIFIC AND ECONOMIC UNCERTAINTIES ABOUT THE MAGNITUDE, TIMING AND IMPACT OF CLIMATE CHANGE REMAIN. HOWEVER, THERE IS A GENERAL CONSENSUS THAT THE RISKS ASSOCIATED WITH INACTION ON GREENHOUSE GAS EMISSIONS ARE TOO GREAT TO WAIT UPON THE RESULTS OF FURTHER RESEARCH BEFORE COMMENCING FIRST ACTIONS. THIS CONSENSUS LEAD TO THE ADOPTION OF THE PRECAUTIONARY PRINCIPLE AT AN INTERNATIONAL CONFERENCE AT BERGEN, NORWAY, EARLIER THIS YEAR. AS INDICATED AT BERGEN, CANADA AND THE MAJORITY OF OTHER COUNTRIES OF THE ECONOMIC COMMISSION FOR EUROPE BELIEVE THAT THE FIRST STEP THAT MUST BE TAKEN IS TO STABILIZE EMISSIONS OF CARBON DIOXIDE AND OTHER GREENHOUSE GASES AT 1990 LEVELS BY 2000.

THE FEDERAL AND PROVINCIAL GOVERNMENTS ARE DEVELOPING A COMPREHENSIVE NATIONAL ACTION STRATEGY ON CLIMATE CHANGE. IT

WILL BE CONSIDERED BY THE CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT IN NOVEMBER. IT WILL ALSO FORM A KEY PART OF THE GREEN PLAN.

THE STRATEGY WILL FOCUS ON ALL ASPECTS OF THE GLOBAL WARMING PROBLEM - REDUCING REMAINING SCIENTIFIC UNCERTAINTIES ABOUT CLIMATE CHANGE, ADAPTING TO THE CLIMATE CHANGE THAT MAY BE INEVITABLE, AND ACTIONS THAT CAN BE TAKEN TO REDUCE EMISSIONS OF GREENHOUSE GASES.

OUR PROPOSED APPROACH TO ACTIONS TO REDUCE EMISSIONS OF GREENHOUSE GASES IS GUIDED BY THREE FUNDAMENTAL PRINCIPLES.

- FIRST, AN EFFECTIVE RESPONSE MUST ADDRESS ALL THE MAJOR GREENHOUSE GASES, NOT JUST CARBON DIOXIDE. AND IT MUST ADDRESS THE IMPORTANT CARBON DIOXIDE SINK OF FORESTS.

- SECOND, AN EFFECTIVE RESPONSE MUST BE MADE IN THE CONTEXT OF INTERNATIONAL ACTION, AS CLIMATE CHANGE IS A GLOBAL PROBLEM WHICH CAN ONLY BE ADDRESSED SUCCESSFULLY THROUGH CONCERTED INTERNATIONAL ACTION. THIS IS NOT TO SAY THAT CANADA'S ACTIONS SHOULD ALL BE CONDITIONAL UPON THE ACTIONS OF OTHER COUNTRIES, BUT THAT THEY MUST BE

DEVELOPED IN THE CONTEXT OF INTERNATIONAL EFFORTS TO DEAL WITH THE PROBLEM. CANADA HAS TAKEN A LEADING ROLE IN MAKING A CONCERTED INTERNATIONAL APPROACH HAPPEN.

- THIRD, OUR UNDERSTANDING OF GLOBAL WARMING IS NOT COMPLETE. THUS IT IS IMPORTANT THAT OUR RESPONSE BE PHASED AND PROGRESSIVE, GIVING US THE FLEXIBILITY TO RESPOND OVER TIME TO NEW INFORMATION AND DEVELOPMENTS. IT MUST ESTABLISH A PROCESS FOR CONTINUALLY MONITORING DEVELOPMENTS, FOR REDUCING UNCERTAINTIES, AND FOR PUTTING CANADA IN A POSITION TO RESPOND WITH APPROPRIATE MEASURES AT EVERY STEP OF THE WAY.

WHILE THE FEDERAL GOVERNMENT BELIEVES THAT THE PRECAUTIONARY PRINCIPLE JUSTIFIES ACTION DESPITE THE UNCERTAINTIES ABOUT CLIMATE CHANGE, IT DOES NOT BELIEVE THAT IT JUSTIFIES ANY OR ALL ACTION - WE MUST BE PRUDENT IN OUR APPROACH. WE WILL START WITH LIMITATION MEASURES WHICH MAKE ECONOMIC SENSE IN THEIR OWN RIGHT, OR WHICH ALSO HELP TO ACHIEVE OTHER POLICY OBJECTIVES - FOR EXAMPLE ENERGY EFFICIENCY INITIATIVES, REFORESTATION, AND ELIMINATION OF CFCS.

IN THE SHORT TERM, THERE IS LITTLE SCOPE TO SUBSTITUTE OTHER FORMS OF ENERGY FOR FOSSIL FUELS, PARTICULARLY IN THE TRANSPORT SECTOR WHICH IS A MAJOR CONTRIBUTOR TO CARBON DIOXIDE EMISSIONS. HYDROELECTRICITY OR NUCLEAR POWER ARE FEASIBLE SUBSTITUTES IN OTHER SECTORS IN SOME REGIONS OF THE COUNTRY, ALTHOUGH WE MUST NOT LOSE SIGHT OF THE FACT THAT THESE SOURCES OF ENERGY CREATE THEIR OWN ENVIRONMENTAL PROBLEMS. IF WE ARE GOING TO REDUCE CARBON DIOXIDE EMISSIONS IN THE SHORT TO MEDIUM TERM, THEREFORE, WE WILL NEED TO FOCUS ON GENERAL ENERGY EFFICIENCY IMPROVEMENTS.

THERE IS EVIDENCE THAT SOME EFFICIENCY IMPROVEMENTS ARE ECONOMIC, AND THEREFORE IN THEIR OWN RIGHT ARE DESIRABLE INVESTMENTS TO MAKE. INDEED, IT IS IMPORTANT TO OUR INTERNATIONAL COMPETITIVENESS THAT CANADIAN INDUSTRY CAPITALIZE ON ALL ECONOMICALLY-VIABLE OPPORTUNITIES TO IMPROVE ENERGY EFFICIENCY. THIS WILL NOT ONLY HELP MAINTAIN CANADIAN COMPETITIVENESS IN THE WORLD MARKET PLACE OVER TIME, BUT IT IS ALSO IMPORTANT TO IDENTIFYING AND DEVELOPING NEW CANADIAN TECHNOLOGIES AND BUSINESS OPPORTUNITIES. IMPROVED ENERGY EFFICIENCY IS THEREFORE NOT ONLY A CHALLENGE, BUT ALSO AN OPPORTUNITY FOR CANADA.

THE GOVERNMENT WILL BE INTRODUCING A INITIATIVES DESIGNED TO PROMOTE ENERGY EFFICIENCY IN THE GREEN PLAN. BUT THESE WILL ONLY BE A FIRST STEP. THERE ARE LIKELY MANY MORE OPPORTUNITIES FOR IMPROVING ENERGY EFFICIENCY - WE WILL NEED TO USE OUR CREATIVITY AND EXPERTISE TO FIND AND CAPITALIZE ON THESE OPPORTUNITIES, CONTRIBUTING TO A HEALTHY, DYNAMIC ECONOMY.

AT THE SAME TIME, HOWEVER, WE MUST RECOGNIZE THAT CHANGES IN THE WAY WE USE ENERGY THAT ARE MORE FAR-REACHING THAN EFFICIENCY IMPROVEMENTS MAY BE NECESSARY. WE THEREFORE NEED TO EXAMINE THESE MEASURES, AND PUT OURSELVES IN A POSITION TO ADOPT THEM IF NECESSARY.

CONCLUSIONS

LET ME SUM UP WHAT I HAVE HAD TO SAY ABOUT ENVIRONMENT, ENERGY AND THE ECONOMY.

FIRST AND FOREMOST, ANY ENVIRONMENTAL POLICY MUST DELIVER A BETTER ENVIRONMENT - CLEAN AIR, WATER AND LAND; A PRODUCTIVE RENEWABLE RESOURCE BASE; PROTECTION OF WILDERNESS AREAS AND

WILDLIFE; AND A NATIONAL CONTRIBUTION TO SOLUTION OF GLOBAL ENVIRONMENTAL PROBLEMS SUCH AS CLIMATE CHANGE.

SECOND, I BELIEVE WE MUST AND CAN ACHIEVE HIGH LEVELS OF ENVIRONMENTAL QUALITY WHILE MAINTAINING A DYNAMIC AND COMPETITIVE ECONOMY. IN MY VIEW, THIS IS NOT ONLY POSSIBLE - IT IS HAPPENING TODAY AS WE WITNESS THE RAPID GROWTH IN THE ENVIRONMENTAL SERVICES AND TECHNOLOGY SECTOR TO MEET THE CHANGING NEEDS OF SOCIETY.

THIRD, A SECURE SUPPLY OF COMPETITIVELY PRICED ENERGY IS A KEY TO ECONOMIC PROSPERITY. ENVIRONMENTALLY SUSTAINABLE ENERGY PRODUCTION AND CONSUMPTION IS ESSENTIAL TO AN ENVIRONMENTALLY SUSTAINABLE ECONOMY. AGAIN, I BELIEVE THIS IS POSSIBLE - THAT ENERGY IS PART OF THE SOLUTION AND NOT PART OF THE PROBLEM. INCREASED ENERGY EFFICIENCY, THE USE OF ALTERNATE FUELS AND THE DEVELOPMENT OF NEW TECHNOLOGIES CAN ALL HELP TO MAKE THIS A REALITY.

IT WILL BE IMPORTANT FOR GOVERNMENTS, INDUSTRY AND ALL SEGMENTS OF CANADIAN SOCIETY TO WORK TOGETHER TO MAKE IT A REALITY. I AM ENCOURAGED BY THE RESULTS OF THE CONSULTATIONS PROCESS, AND THE RAPPORT DEVELOPED IN THOSE MEETINGS. ENVIRONMENT CANADA

WILL CONTINUE TO WORK WITH THE ENERGY AND OTHER SECTORS TO FIND SOLUTIONS TO OUR ENVIRONMENTAL PROBLEMS. FOR EXAMPLE, ENVIRONMENT CANADA HAS FOR THE FIRST TIME BECOME A SPONSOR OF CERI. WE LOOK FORWARD TO WORKING WITH THEM. AND WE LOOK FORWARD TO WORKING WITH THE ENERGY SECTOR.

I WOULD LIKE TO END WITH AN OBSERVATION MADE BY THE PRIME MINISTER, IN AN ADDRESS TO THE WORLD ENERGY CONFERENCE IN MONTREAL THIS TIME LAST YEAR WHICH CAPTURES THE MESSAGE I HAVE TRIED TO PRESENT HERE. HE SAID "CANADA IS IN THE ENERGY BUSINESS IN A BIG WAY, AND WE ARE GOING TO STAY IN THAT BUSINESS". HE WENT ON TO SAY: "BUT THIS DOES NOT MEAN THAT WE ARE GOING TO DO SO AT THE EXPENSE OF OUR NATURAL ENVIRONMENT. THERE IS NO NECESSARY CONFLICT BETWEEN GOOD ENVIRONMENT POLICY AND GOOD ENERGY POLICY. IN FACT, PROPERLY CONCEIVED, THEY REINFORCE EACH OTHER."

THANK YOU.

THE ENVIRONMENTAL CHALLENGES FOR THE OIL INDUSTRY

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Calgary, Canada
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ABSTRACT

Energy provides the critical and crucial link between economic development and environmental quality. Without energy, particularly fossil energy used extensively since the industrial revolution and for the foreseeable future, economic development would not be feasible. Energy, again particularly fossil fuels, have major influence on the quality of the environment. Rational management of energy is therefore imperative to development and environment. As fossil fuels currently account for about two thirds of total energy demands, the oil industry has a pivotal role to play in reconciling the needs for development and environment.

The paper reviews ten environmental challenges that confront the oil industry. These are:

1) the confluence of population increase, urbanization, unsustainable forms of development, depletion and destruction of critical life support systems;

2) the imperative need for accelerated energy efficiency measures which would result in greater emphasis on production of goods and services that increase human welfare without the related increase in energy consumption as well as the probability of the establishment of national/international carbon emission targets;

3) the democratization process that is occurring in Eastern Europe will have influence in other regions of the world, resulting in increased public participation in energy policy decision making;

4) greater trends towards and public preference/demand for "climate-friendly" technology;

5) the potential requirements to provide information, notification and consultation on activities likely to cause significant climate change and loss in biological diversity;

6) the demands by developing countries for the transfer of environmentally sound technologies, at concessional terms, as well as the availability of new and additional financial resources;

7) the growing not-in-my-backyard syndrome for technological installations, such as refineries, terminals, petrochemical complexes;

8) trends towards "cradle-to-grave" approach for the management of toxic chemicals and hazardous wastes as well as labelling of products;

9) increasing demands for "green" products and resultant eco-labelling;

10) more fiscal, economic and legislative measures, in the forms of incentives and disincentives to respond to environmental challenges. As environmental problems have regional and global impacts, there would also be increases in international legal instruments, such as conventions and protocols to facilitate international cooperation.

The paper concludes by pointing out the increasing acceptance and consensus that sustainable forms of development must be conceived, planned and implemented to generate the wealth necessary to improve standards of living and create the financial resources needed to protect and manage the environment as well as help achieve the elimination of poverty.

Decisive actions need to be taken expeditiously to confront the environmental challenges. Delays will cause subsequent actions to be much more difficult and costly to implement.

The oil industry, with its formidable technical expertise, managerial know-how and financial resources, has a critical role to play - directly through its many faceted operations, as well as through its very wide range of customers that depend on energy.

THE ENVIRONMENTAL CHALLENGE
EFFECT ON NATURAL GAS DEMAND IN EUROPE

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1. NATURAL GAS AND THE ENVIRONMENT

It is well known that the impact of combustion on the environment and, in particular, on atmospheric pollution, reflects the combined effects of the overall efficiency of the energy cycle (production, treatment, transport and end use) and of the specific emission rates of fuels per burned energy unit.

From both these points of view natural gas has a large advantage against all other fuels. Its global energy efficiency is normally higher under the same conditions of utilization and, moreover, a large choice of equipment and machinery is available permitting natural gas used with efficiencies which are considerably higher than that of other fuels.

In relation to the emission of polluting compounds it will be enough to recall that the combustion products produced by natural gas are practically sulphur dioxide and dust free and that nitrogen oxide emissions are lower than those produced in the combustion of other fuels.

(Slide 1) Figure 1 shows typical emission values for various fuels in different uses without any action to reduce the level of nitrogen and sulphur oxides.

(Slide 2) As can be seen natural gas has a clear advantage, which should be sufficient to bring about a large increase in its use, but in Europe the EC Authorities, probably afraid of a generalized increase in the use of natural gas in a period when there was a strong effort to push nuclear energy and coal, issued the 1988 Directive on large combustion plants which seems clearly aimed at promoting coal use by penalizing natural gas (figure 2).

(Slide 3) This is achieved both by strongly differentiating emission limits for the different fuels and by the choice of emission units (mg/m^3 of dry flue gas) and the reference conditions to calculate flue gas volume (6% oxygen for coal and 3% for oil and gas). The end result of this is clear in the emission limits per TOE burned as shown in figure 3.

The emission limits set for coal, particularly for units smaller than 100 MW, are such that it will be possible to stay within just by fly ash removal, which is already current practice.

Besides these numerical elements, the EC Directive also tends to limit gas use requiring that, in the case of a mix of different fuels being used, the emission limit must be the mean of each fuel emission limit weighted on the base of the quantities used.

It is clear that in such a situation there is no incentive to co-fire natural gas and high sulphur fuel oil or coal to reduce emissions.

Having said this about the impact of EC environmental regulations on the use of fuels, I would like to deal further with the environmental effect of combustion with regard to the greenhouse effect.

The most important chemical compounds produced in the combustion of fossil fuels influencing global warming are carbon dioxide, nitrous oxide and methane.

As far as carbon dioxide is concerned, the combustion of natural gas produces emissions which are substantially lower than those of other fuels. The same thing can be said about nitrous oxide which, even if present in relatively small quantities in combustion products, is very efficient in the absorption of infrared radiation. In this sense methane is also more efficient that CO_2 but, fortunately, its atmospheric lifetime is less than one tenth of that of carbon dioxide: this reduces proportionally its effect as a greenhouse gas.

Nevertheless the natural gas industry has been accused of emitting into the atmosphere such large quantities of methane as to offset its lower emissions of carbon dioxide and nitrous oxide. I would now like to examine the issue, sticking to the facts.

(Slide 4) The available data seem to indicate average methane losses of less than 1% of the utilized volumes for the whole energy cycle from production to end use. In the light of this we should look at the result of a comprehensive quantitative comparison of the impact of different fuels on the greenhouse effect based on carbon dioxide equivalent emissions taking into account each compound's efficiency as a greenhouse gas and its average atmospheric lifetime. This result is given in figure 4 where total carbon dioxide equivalent emissions are given for coal, fuel oil and natural gas vs. methane losses. As can be seen, such losses should reach 40% of the fuel burned to make natural gas equivalent to fuel oil and 70% for an equivalence with coal. These figures may vary slightly with the underlaying assumptions, but they stand at a level which is at least one order of magnitude higher than real losses.

In the light of this an increase in natural gas use certainly appears to be a viable option to reduce the effect of fossil fuel burning on global warming.

2. PRESENT SITUATION OF NATURAL GAS IN EUROPE

(Slide 5) We can start the analysis of the present situation of natural gas in Europe by looking at the total consumption of primary energy and natural gas in the EC between 1973 and 1988 (figure 5). Natural gas consumption increased in this period by more than 60%, at an average yearly rate of 3.3%. However 50% of the increase was concentrated in the first six years with the build-up of the large gas supply contracts signed in the early years of the decade. At present the natural gas market share is more than 17% of primary energy.

Looking at the situation of natural gas use in the EC, we must consider a still standing 1975 directive limiting the use of natural gas for electricity production in new power plants. At present there seems to be a general consensus for its repeal and this would facilitate gas use particularly in high efficiency power production, for instance in combined cycle power plants or in the gas repowering of existing power stations. In the other Western European countries the share of natural gas in primary energy supply has been somewhat lower for different reasons. In 1988 natural gas consumption in Western Europe as a whole was 203 million TOE vs. a primary energy consumption of 1979 million TOE, with a share of 16%.

(Slide 6) Within these global figures there are large differences in natural gas use from country to country. Figure 6 shows the share of natural gas as primary energy by country. As can be seen we go from countries with no natural gas use, like Greece and Portugal to others with high shares like The Netherlands, the United Kingdom and Italy. We may add that Greece and Portugal intend to develop a national gas system in the near future with the help of the EC.

(Slide 7) If we also take into consideration the countries of Eastern Europe, with the exclusion of USSR, we obtain the situation shown in figure 7. We must remember that in the Eastern European countries there is a critical environmental situation which, together with actions to reduce lignite and coal consumption and to lower emissions from oil and coal burning units, will presumably accelerate gas penetration.

In total, gas consumption in European countries excluding USSR was about 350 billion cubic metres in 1989.

3. PROSPECTS FOR NATURAL GAS DEMAND

We can start examining the prospects of natural gas demand in the next ten or twenty years by looking at some scenarios regarding the EC.

In 1989 the EC Commission issued the discussion paper "Energy in Europe" with the detailed analysis of what could happen to the energy market in the Community in the next twenty years. The study is based on three main scenarios called:

A - Conventional wisdom
B - Driving into tension
C - Sustaining high economic growth.

(Slide 8) The main assumptions made for each alternative are shown in figure 8.

Alternative A is based on steady economic growth with gradual development of existing policies and of technology. Market forces drive the system within the existing framework.

Alternative B takes into account what could go wrong without appropriate policy measures: supply capacities will come under pressure and polluting emissions will attain high levels.

Alternative C reflects a strong action toward strict environmental standards, higher efficiency and improved consumer behaviour.

(Slide 9) The results of the various assumptions on energy consumption and energy mix are shown in figure 9.

As can be seen, the strong influence of environmental concern in alternative C results in a sharp reduction in oil and, especially, coal consumption relative to scenarios A and B and in a strongly reduced total energy demand. In this alternative the share of natural gas in the EC is expected to reach 27.7% with an average yearly volume increase of 2.3% between 1987 and 2010.

As a gas man, in a Conference dealing with the environmental challenge, I should suggest that alternative C is the more likely one, but I'm afraid that it is not the general feeling of the European gas industry. In fact, the figures for gas expansion in the various countries add up to an expected demand between alternatives A and B in the year 2000 and more in the A side in 2010.

My opinion is that this forecast reflects the cautious attitude of the gas industry in its long term plans in the light of the heavy contractual commitments and the big investments that new projects require.

Regulations also have their part: for instance, the EC gas industry is disturbed by the possible introduction of common carriage in gas transport. The lack of confidence in the volume of the market that gas utilities are going to serve directly dictates great caution in taking long term commitments with the ensuing take or pay obligations and heavy financial burns.

As regards the other Western European countries and the Eastern European ones, the development of the gas market should not differ too much from that of the EC.

On the one hand there are environmental concerns which would justify a sharp increase in the use of gas, but on the other hand there are doubts about the financial and industrial means needed to support such a development.

Finally, for all countries we must consider the fact that a large market growth requires imports from areas which are increasingly far, with infrastructural costs which are bearable only at relatively high energy prices.

In this regard there is a general consensus on a scenario of prices increasing in real terms, but there is not much agreement on the level of such an increase.

For instance EC scenario B gives, for the year 2010, a crude price of 40 $ (87)/barrel which might make it possible to realize large infrastructures for gas imports from remote areas like Middle East once the necessary political and contractual guarantees have been obtained, but scenario C, characterized by the highest gas consumption, gives a crude oil price of 20 $ (87)/barrel in the same year. In such a situation the development of the natural gas market would require a set of tax provisions on the more polluting fuels alternative to gas or rules and regulations on environmental protection imposing the use of gas even when gas prices reach such a level to cover the higher cost of supply.

Recent evaluations on damage to the environment and to human health caused by the combustion of various fuels show rather substantial differences between natural gas and heavy fuel oil and natural gas and coal with values up to 2 $ per million BTU. These evaluations mainly take into account damage caused by traditional polluting compounds such as sulphur dioxide, nitrogen oxides, dust, heavy metals and so on but more recently there have been other proposals for taxes on fuels as a protection from global warming: the so called carbon tax. Here again there may be a further differential in favour of natural gas to allow for costly infrastructures even at low energy prices. Naturally this is very uncertain ground particularly in terms of supporting long term projects.

(Slide 10) Taking all these matters into consideration figure 10 gives some values of natural gas consumption in the years 2000 and 2010. Such figures take into account gas utility forecasts when available, international studies on gas development and general considerations on technological and environmental issues.

From this figure we can see that a sharp increase in gas consumption is to be expected by the year 2000. Eastern and Western Europe should move at about the same pace with an average yearly rate of about 2.6% which is considerably higher than that of the last ten years.

We might say that in the next twenty years there should be a new wave of gas demand similar to what happened in the years from 1970 to today with a sharp build up followed by a gradual saturation.

In total, the yearly gas consumption in Europe, excluding USSR, should grow by about 45% between now and the year 2010.

As regards the various utilization sectors, forecasts vary by geographic area.

In Western Europe a big increase in thermoelectric use is to be expected due to the evident advantages natural gas presents in the fields of investment cost, energy consumption and environment.

Lower growth rates are expected in absolute values for the residential, commercial and industrial sectors. In this last one there should be a growing diffusion of cogeneration, particularly with the use of gas turbines. The other end uses should remain roughly constant in absolute terms. A small sector which might have interesting prospects of development for environmental reasons is the use of compressed natural gas for vehicle use but it is not yet possible to make any forecast in this field because of the high degree of uncertainty related to regulatory actions, to the availability of cars specifically designed and built for gas use and of a sufficient network of filling stations as well as the reaction of drivers to the use of gas.

In Eastern Europe the situation is substantially different. In the industrial sector gas consumption is already high and it seems likely that more efficient gas fired equipment and processes will substantially reduce the specific energy consumption so that even large substitution of coal by natural gas may not result in much higher levels of gas demand. The power generation sector already accounts for about one third of gas use so that consumption in this sector is expected to increase in absolute terms but not as a share of the gas market.

On the contrary, the expected improvement in the standard of living will presumably increase sharply the demand for gas in the residential and commercial sector which is expected to contribute about 40% of the increase in demand.

4. CONCLUSIONS

The present situation of tension on the energy markets may affect the pattern of change we have seen: energy consumption may drop again and new efforts may be devoted to diversification particularly towards renewable energy sources and safer nuclear plants.

In this picture gas could still fit in as a viable source of diversification from oil and as a fuel used in high efficiency equipment. Its benign environmental characteristics, in particular regarding acid emissions and global warming, should favour a further development of its market in absolute terms and in percentage.

All this would probably happen anyway, but it can take place faster if the public authorities recognize the potential role of natural gas and provide the proper regulatory environment for its growth.

FIGURE 1
UNCONTROLLED EMISSION VALUES FROM COMBUSTION OF FOSSIL FUELS (1)
(KG/TOE)

FUEL	USE	DUST	SO_2	NO_X
FUEL OIL	IND.	4.8	21-83	13
	THERMOEL.	2.3	21-63	13
COAL	IND.	15 (2)	32	17
	THERMOEL.	1.5 (3)	29	23
GASOIL	SP. HEATING	0.34	5.9	2.5
NATURAL GAS	SP. HEATING	0.06	0.02	1.9
	IND.	0.06	0.02	2.7
	THERMOEL.	0.06	0.02	12.0

(1) BASED ON ITALIAN FUEL QUALITY
(2) WITH 95% ASH REMOVAL
(3) WITH 99.5% ASH REMOVAL

FIGURE 2
EMISSION LIMITS FOR NEW PLANTS HAVING A THERMAL POWER HIGHER THAN 50 MW - CEE - 88/609
(MG/M^3) (7)

	DUST	SO_2	NO_X
FUEL OIL	50-100	400 (1) 1700 (6)	450
COAL	50 (1) 100 (2)	400 (1) 2000 (3)	650 (4) 1300 (5)
NATURAL GAS	5	35	350

(1) POWER ≥ 500 MWt
(2) POWER < 500 MWt
(3) POWER = 100 MWt
FOR POWER FROM 100 TO 500 MWt LINEAR CHANGE
(4) VOLATILE COMPOUNDS ≥ 10%
(5) VOLATILE COMPOUNDS < 10%
(6) POWER ≤ 300 MWt
FOR POWER FROM 300 TO 500 MWt LINEAR CHANGE
(7) DRY GAS WITH OXYGEN CONTENT OF 3% FOR LIQUID AND GASEOUS FUELS AND 6% FOR SOLID FUELS

FIGURE 3

EMISSIONS LIMITS FOR NEW PLANTS HAVING A THERMAL POWER HIGHER THAN 50 MW - CEE 88/609

(KG/TOE)

	DUST	SO_2	NO_x
FUEL OIL	0.6-1.2	4.9 (1) 21.0 (6)	5.6
COAL	0.8 (1) 1.6 (2)	6.3 (1) 31.5 (3)	10.2 (4) 20.4 (5)
NATURAL GAS	0.06	0.4	4.0

(1) POWER ≥ 500 MWt
(2) POWER < 500 MWt
(3) POWER = 100 MWt
FOR POWER FROM 100 TO 500 MWt LINEAR CHANGE
(4) VOLATILE COMPOUNDS ≥ 10%
(5) VOLATILE COMPOUNDS < 10%
(6) POWER 300 MWt
FOR POWER FROM 300 TO 500 MWt LINEAR CHANGE

FIGURE 4

TOTAL EMISSIONS FROM THE COMBUSTION OF FOSSIL FUELS CO_2 EQUIVALENT AS GREENHOUSE GAS

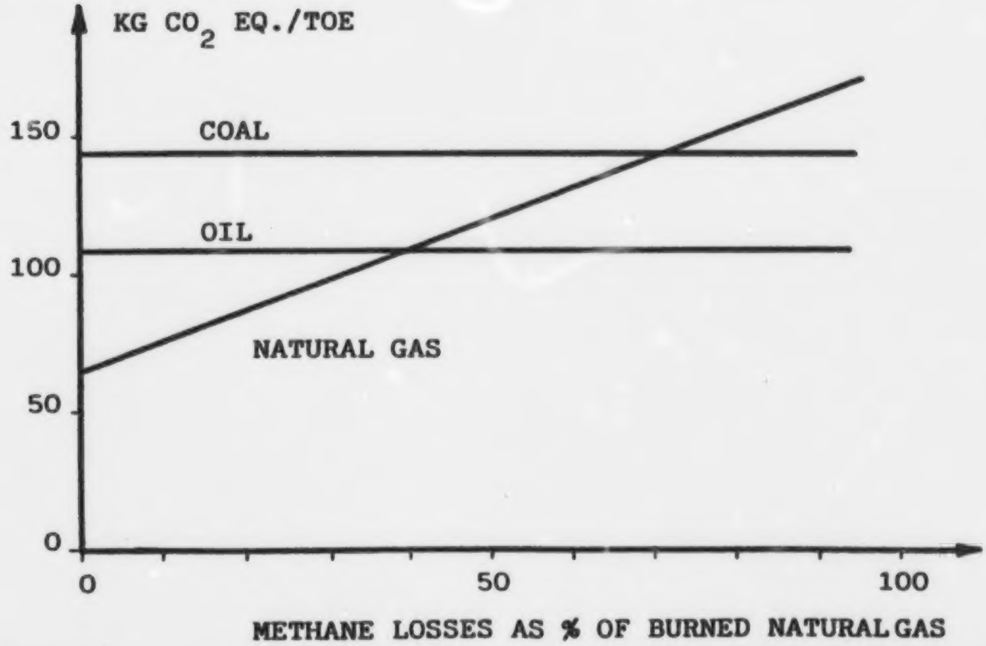

FIGURE 5
PRIMARY ENERGY AND NATURAL GAS CONSUMPTION IN THE EEC AND IN WESTERN EUROPE
(MTOE)

	1973	1979	1986	1988
A - EEC				
PRIMARY ENERGY	1022	1103	1070	1107
NATURAL GAS	118	177	189	193
B - WESTERN EUROPE				
PRIMARY ENERGY	1162	1257	1240	1279
NATURAL GAS	121	183	199	203

FIGURE 6
NATURAL GAS SHARE OF PRIMARY ENERGY
WESTERN EUROPE - 1988

AUSTRIA	16.7%
BELGIUM	15.6%
DENMARK	7.3%
FINLAND	4.9%
FRANCE	12.1%
W. GERMANY	16.0%
GREECE	---
IRELAND	17.3%
ITALY	21.9%
LUXEMBOURG	6.4%
THE NETHERLANDS	47.0%
NORWAY	6.0%
PORTUGAL	---
SPAIN	4.0%
SWEDEN	0.5%
SWITZERLAND	5.0%
UNITED KINGDOM	23.4%
YUGOSLAVIA	13.0%

FIGURE 7
NATURAL GAS CONSUMPTION AND SHARE OF PRIMARY ENERGY DEMAND IN EUROPE (*)

	1973		1979		1986		1988	
	MTOE	%	MTOE	%	MTOE	%	MTOE	%
W. EUROPE	121	10	183	15	199	16	203	16
E. EUROPE	39	12	61	15	73	16	74	16
TOTAL	160	11	244	15	272	16	277	16

(*) EXCLUDING USSR

FIGURE 8
SCENARIOS CONSIDERED IN EEC DISCUSSION PAPER "ENERGY IN EUROPE"

A: "CONVENTIONAL WISDOM" - BUSINESS AS USUAL - ENERGY SYSTEM DRIVEN BY MARKET FORCES - INERTIAL TECHNOLOGICAL IMPROVEMENT
GDP + 2.7%/YR

OIL PRICE ($ 1987):	1995	17.5	$/BBL
	2000	20	"
	2010	30	"

B: "DRIVING INTO TENSION" - HIGH ECONOMIC GROWTH WITHOUT APPROPRIATE POLICY MEASURES
GDP + 3.5%/YR UP TO 2000
2.5 " 2000-2010

OIL PRICE ($ 1987):	1995	20	$/BBL
	2000	26.5	"
	2010	40	"

C: "SUSTAINING HIGH ECONOMIC GROWTH" - STRICT ENVIRONMENTAL STANDARDS - ENERGY CONSERVATION
GDP + 3.5%/YR UP TO 2000
3.0 " 2000-2010

OIL PRICE ($ 1987):	1995	20	$/BBL
	2000	25	"
	2010	20	"

FIGURE 9
EEC ENERGY DEMAND FROM THE DISCUSSION PAPER "ENERGY IN EUROPE" (MTOE)

	1987	1995		2000			2010		
		A	B-C	A	B	C	A	B	C
SOLID FUEL	231	246	263	275	325	245	322	400	107
OIL	506	572	602	560	630	565	524	567	369
NATURAL GAS	198	233	254	249	285	290	277	327	335
PRIMARY ELEC.	180	230	230	249	255	255	307	320	389
OTHERS	2	3	4	4	5	6	6	7	10
TOTAL	1117	1284	1353	1337	1500	1361	1436	1621	1210

FIGURE 10
DEVELOPMENT OF NATURAL GAS IN EUROPE (*) (MTOE)

	1988	2000	2010
EEC	193	260	275
W. EUROPE	203	280	300
E. EUROPE	74	100	120
TOTAL	277	380	420

(*) EXCLUDING USSR

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THE ENVIRONMENTAL CHALLENGE : IMPLICATIONS FOR NATURAL GAS SUPPLY DEVELOPMENTS

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SUMMARY

Natural gas is a clean fuel and its use has made a significant contribution to the quality of ambient air as reflected in the concentrations of particulates, sulphur dioxide and nitrogen oxides, particularly in urban areas.

Increased use of natural gas, especially when associated with modern highly efficient applications, will be beneficial not only in terms of conventional pollution but also in contributing towards the abatement of global warming.

There are already widespread estimates of increased markets over the next few decades. Substantial reserves of natural gas are available to meet future growth and methods for transporting supplies have been proven.

Concern for the environment has now spread to the general public and to most areas of the world. Those involved in the supply and use of natural gas are subject to constraints that tend to become more demanding as understanding of the issues improves and pressures from the public increase.

Global warming is an issue that has attained enormous significance in the last few years. Debate of that issue focussed attention on emissions of methane from the fossil fuel industries. Estimates of such emissions from the natural gas industries do not substantially affect the fuel's advantageous position with respect to carbon dioxide emissions.

The involvement of the public and other environmental issues make it unlikely that pressures on the gas industry will decrease. It will

require patient and well informed expertise to ensure that there is harmonious development of new supply systems. One factor that may help ensure success is the education of staff, at all levels in gas companies, about the principles and relevance of environmental issues to natural gas industry.

THE ENVIRONMENTAL CHALLENGE:
IMPLICATIONS FOR NATURAL GAS SUPPLY DEVELOPMENTS.

INTRODUCTION

For the gas business, globally, these are exciting and challenging times. There has already been a significant growth in the use of natural gas over the last few decades in most areas of the world; Table 1(1) shows the markedly increased use which has occurred in the UK, Africa, South America, Asia, Eastern Europe and the Middle East. Natural gas now accounts for 20 per cent of the world's primary energy consumption. Over 250 billion m^3, about 13% of that produced, is traded internationally and that percentage seems set to rise. One of the factors that has led to the increased demand in the environmental benefit that arises from its use.

ENVIRONMENTAL BENEFITS OF NATURAL GAS

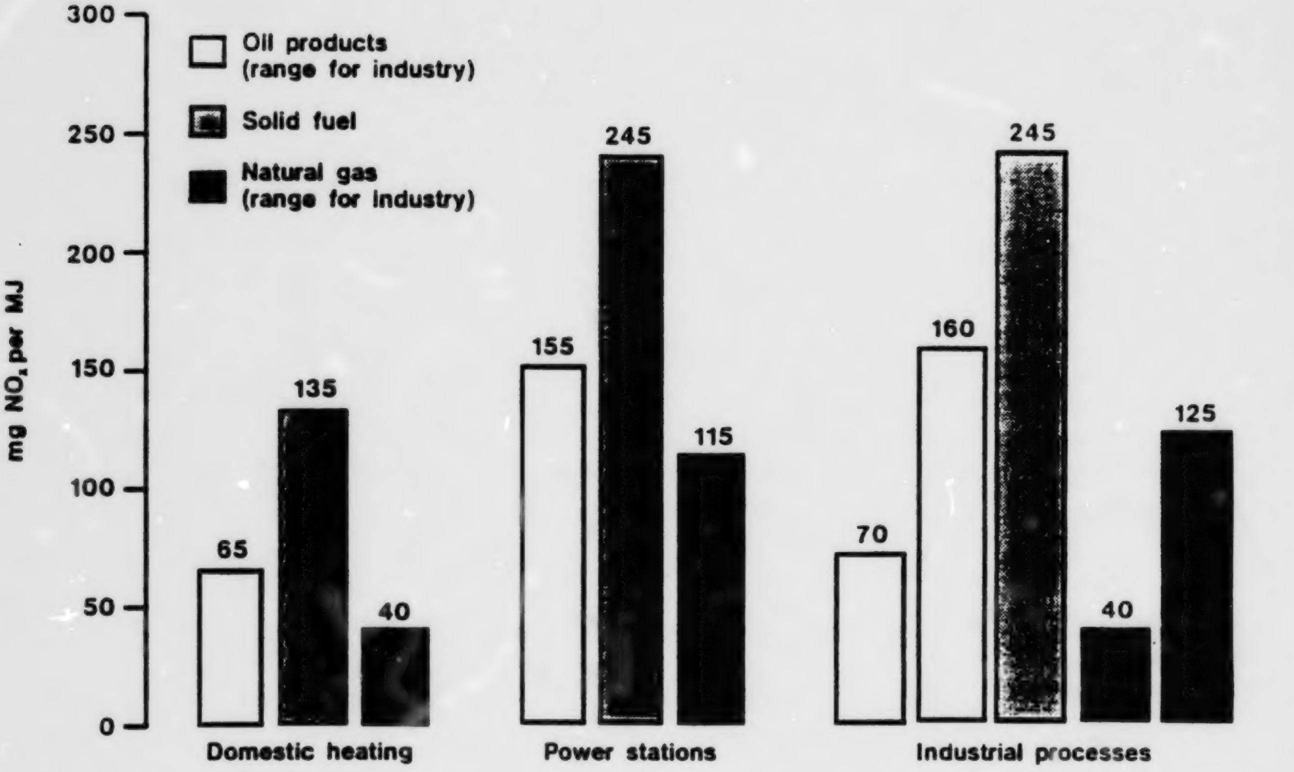
Achievements in Air Quality

The use of fossil fuels has for many years been critically assessed in terms of their potential damage. The main pollutants discharged to air from combustion are particulates, sulphur dioxide and nitrogen oxides. The initial concern of such assessments was human health and local measures were eventually introduced to abate the known effects. However as the knowledge of complicated mechanisms of pollution developed further the effects of dry and wet deposition of pollutants on materials, on the water quality of rivers or lakes, and on vegetation assumed enormous political as well as technical importance. The legal framework for controlling pollution developed further from instruments of local legislation to those of international agreements, Conventions and

Protocols. In North America and Western Europe there was considerable pressure for tighter emission control, particularly of sulphur dioxides and nitrogen dioxides, and that brought the prospect of installing expensive abatement measures or the use of alternative forms of energy. The use of natural gas in urban areas has already made considerable contributions to the improvements of air quality not only through the reduction of smoke levels but also by significantly reducing the emissions of sulphur dioxide and hence its concentration in ambient air.
The quality of ambient air also depends on the presence of nitrogen oxides and emissions from nitrogen oxides from the combustion of natural gas must be considered too. They can contribute to acidic deposition as well as to the formation of other polluting species, such as ozone through interactions with hydroxyl radical and hydrocarbons. However here too the preferential use of natural gas has an overall beneficial effect because, unlike coal and oil it does not have, within the fuel itself, chemically based nitrogen compounds which contribute to the total nitrogen oxides emission from coal and oil combustion. Natural gas, which in 1987 accounted for 18% of the primary energy in the EC, yielded only approximately 6% of the total nitrogen oxides emissions.

Figure 1 shows the emission factors from different fossil fuels used for power generation, and industrial and domestic use. These are averaged values, for example nitrogen oxides from industrial use of oil may vary from 70 to 160 $mg.MJ^{-1}$ while those from natural gas may vary from 40 to 125 $mg.MJ^{-1}$ but, together with the fact that there is negligible emissions of particulates and sulphur dioxides, they emphasize the overall advantage of natural gas.

FIGURE 1 - NITROGEN OXIDES EMISSIONS



Source: Warren Spring Laboratory Estimates

The Greenhouse Effect

For many years discussion of the environmental benefits of natural gas use has focussed on local use and on the direct chemical effects of pollutants. The most recent emphasis on the use of fossil fuels has been on their contribution to climate change through the emission of greenhouse gases particularly carbon dioxide.

The greenhouse effect has of course been recognised for many years. Water vapour makes the largest contribution towards this effect but in practice attention usually focuses on the contribution from trace gases such as carbon dioxide, methane, chlorofluorocarbons, nitrous oxides and ozone.

It is known that the concentration of these trace gases in the atmosphere has been increasing. There is evidence that the average global temperature has increased by about 0.5°C over the past century. What is not proven beyond all doubt is that the increased concentrations of these gases caused that temperature increase, or that the temperature increase is outside the range of previous variations. However the predicated rate of change is said to be much greater than has ever been seen over the last 160,000 years. There is now a growing concern that it would be folly to wait until there is absolute proof of the cause and effect before remedial measures are taken.

Although there are some sceptics who remain unconvinced, and it is acknowledged that there are many areas of uncertainty, there does seem to be a consensus among the experts in the three Working Groups (WGs) of the Intergovernmental Panel on Climate Change (IPCC)(5) that there is a real global warming effect. The IPCC met in Sweden this autumn to consider the reports of the three WGs on the scientific assessment of climate change, its potential effects and strategies for remedial measures. The delegates there accepted the reports. The overall report by the IPCC Chairman will be discussed at the Second World Climate Conference at Geneva in November. Work will start soon on a framework Convention which is expected to be ready for signing at the World Conference on Environment and Development in Brazil in 1992. Not surprisingly there are some countries who are anxious that the production of specific protocols should not be rushed because of the uncertainties and the perceived economic costs. Nevertheless there is also a consensus that any measures already agreed, such as the reduction in the emissions of chlorofluorocarbons should be continued. Those abatement measures that are seen to be cost effective, such as energy conservation and improvements in the efficiency of energy use, should be implemented as soon as possible.

Some countries have already responded to the call for abatement of carbon dioxide emissions laid out in the Toronto Statement and have indicated target dates for stabilizing or reducing their emissions of carbon dioxide. There are a variety of approaches put forward to reduce emissions in a way that would be acceptable to all including the less developed nations. Proposed mechanisms for implementing such a policy have included tradable emission permits, emission charges, subsidies and sanctions.

The use of natural gas makes a significant contribution towards reducing the emissions of greenhouse gases because the relative amounts of carbon dioxide released from the combustion of equivalent amounts of energy in natural gas, oil and coal are approximately in the ratios 0.6:0.8:1.0

These factors all combine to reinforce the view that natural gas is the most favoured fossil fuel in environmental terms and, provided it can be supplied at suitable price and in sufficient quantities, there are ample market opportunities for its use.

SUPPLYING DEMAND

The proven reserves of natural gas at the end of 1988 are now given as 58 times the world production compared with a corresponding figure of 41 for oil reserves(2). It is important to remember that figures for the reserves of natural gas are probably very conservative because most natural gas was discovered when gas was not the main focus of the exploration activity. The increasing international market in gas is probably changing that emphasis, and reserves of natural gas may then be sought with the same diligence as those of oil have been in the past.

TABLE 1 SUMMARY OF NATURAL GAS CONSUMPTION BY END-USE FOR SELECTED COUNTRIES (Thousand tonnes of oil equivalent*)

Region	1971	1986
UK (industry only)	4851	12667
Africa		
Inland consumption	1660	29078
Power generation	389	9730
Energy sector	857	13761
Chemical/petrochem		1941
Iron and steel ind.		234
Residential	55	857
South America		
Inland consumption	22454	66054
Power generation	4953	12900
Energy sector	8102	18326
Chemical/petrochem	2019	11866
Iron and steel ind.		2486
Residential	701	5698
Asia		
Inland consumption	5287	45277
Power generation	552	86010
Energy sector	1897	8990
Chemical/petrochem	n.a.	10778
Iron and steel ind.	n.a.	1974
Residential	271	2754
E. Europe CPE's		
Inland consumption	265067	529725
Power generation	89798	193028
Energy sector	18971	7869
Chemical/petrochem	23570	50897
Iron and steel ind.	27131	38176
Residential	31509	61133
Middle East		
Inland consumption	14214	47176
Power generation	1339	14775
Energy sector	1590	4159
Chemical/petrochem	417	6564
Iron and steel ind.		219
Residential	417	1131

* one thousand tonnes of oil equivalent = 1.167 million m^3 natural gas
= 425 thousand therms

International trade in natural gas requires adequate means of transport. There is already an intricate network of high pressure pipelines in North America and within Europe there is an effective transmission system with links to the reserves in the USSR, Algeria, Norway and the Netherlands. There have been plans to expand this network with more links including a further link between Spain and Algeria; a pipeline between the UK and Continental Europe is always possible. There have also been serious proposals to join Iran, and other reserves in the Middle East, to the European grid and speculation about a link, in the long term, from the Barents Sea through Scandanavia into the present European system.

The other alternative for transport of large quantities is as liquefied natural gas (LNG) a technology which is well proven worldwide. Both the necessary LNG terminals and modern carriers have a long record of successful operation.

There are obviously substantial resources of natural gas available and an increased use has already been anticipated by experts in the energy business. At the time of the World Energy Congress in Montreal last year there were published indications of the planned increased use of natural

TABLE 2 - NATURAL GAS FOR PRIMARY ENERGY PRODUCTION (MTOE*) 1985 - 2020

Year	1985	2000		2020	
		M	L	M	L
Industrialised nations	1221	1605	1490	1720	1520
Third world	211	455	363	733	553
Total natural gas	1432	2060	1853	2453	2073

*one million tonnes of oil equivalent (mtoe) = 1167 million m^3 natural gas
= 425 million therms

gas. Data on the production of natural gas for primary energy in 1985, and projected data for the years 2000 and 2020 that would arise as a result of medium (M) and limited (L) growth, published(3) by the World Energy Conference, (now the World Energy Council, (WEC)), are shown below in Table 2.

The data show increases of between 24% and 41% for industrialised nations, between 153% and 247% for third world countries, and world wide showed an increase from 45% to 71%.

Projections of the European Community's energy needs had been assessed around the same time by the European Commission(4) using various different scenarios for possible future situations.

Scenario 1 was for steady unspectacular growth with improved efficiency of use and energy demand driven by market forces - more or less a reflection of conventional wisdom. Under this Scenario, one of the areas of growth for natural gas was power generation, rising from 28.5 mtoe to 46.56 mtoe. That use is discussed later in this paper.

Scenario 2 was for high economic growth driven by market forces, with energy supply being outstripped by demand and with high pollution levels.

Scenario 3 was for high economic growth in a clean environment, with limitations on energy consumption and more efficient means of production. A selection of the data relevant to natural gas is shown in Table 3.

All three scenarios show a growth in the use of natural gas both in absolute terms and in the fraction of final energy supplied. Since these projections were published there have been many statements about increased markets for natural gas. More recently the debate on global warming has focussed on the possibility of fuel switching to natural gas. Thus the estimates above may be rather conservative.

There are substantial reserves of natural gas to meet such projected demands. It is also generally acknowledged that in Western Europe at least there is spare capacity in the system to ensure its supply.

TABLE 3 - PROJECTIONS OF EUROPEAN COMMUNITY'S NATURAL GAS DEMAND

Year		Natural Gas Demand			
		Primary Energy mote	Primary Energy % total	Final Energy Use mote	Final Energy Use % total
1987		198	18	166.8	23.8
2010	Scenario 1	276	20	218.9	25.7
2010	Scenario 2	327	21	265.2	27.5
2010	Scenario 3	335	29	220.2	31.3

Despite recent political developments in Eastern Europe, and the Middle East, it seems likely that long term supply of natural gas will be sufficient to meet the needs in those regions where an appropriate infrastructure is already in place. Provided the sources remain available the main barrier to its provision or use is the possibility of environmental constraints.

ENVIRONMENTAL CONSTRAINTS

The overall picture for the supply of natural gas and its benefits in use look good but several factors have placed more emphasis on the need to avoid any complacency and a requirement to pay even closer attention to a range of related environmental topics.

Of particular importance is the marked growth in the level of concern, about environmental protection, expressed by the general public. No longer is it isolated, ill informed pressure groups who are doing the lobbying. Pressure groups are usually well informed and the man in the street has become involved. The use of television in particular has played a dominant role in consolidating that public concern although information may be incorrect! That was reflected in the results of a recent survey by the gas industry in Canada. Gas got a good rating but a large fraction of those interviewed rated electricity as the cleanest form of energy!

The importance of the electorate's views has been reflected in the fact that the 'green' political parties, which sprang up a few years ago, had a relatively short life because the main line parties quickly realised that they would have to be seen to be taking these issues on board if they were to maintain political power.

The advent of *perestroika* in the USSR and Eastern Europe has demonstrated that similar movements are taking place there(6). Public movements have already succeeded in closing several polluting factories in different areas and in stopping some unacceptable projects. The exploration and development activities associated with the gas field in the Yamal province of Siberia have resulted in strong opposition from Soviet environmentalists and in claims for compensation for alleged damage already done.

Everywhere there is an increased requirement to provide information to the public on these matters and a world-wide growth in environmental audits of industrial activity, including gas operations, will ensure that attention of the local population to protection of the environment will be maintained.

Another factor which has increased the pressure on industrial activities has been the long term shift from the situation where emphasis was mainly on local pollution issues to one where the emphasis has broadened to include environmental issues with national, transfrontier and global concerns. A related development is the involvement not just with what is happening in the country of residence but with activities much further afield whether they involve pandas, seals, whales, rain forests or tundra. The importation or continuation of bad environmental practice in less developed countries, or remote locations, is increasingly becoming less acceptable. Companies involved in enterprises in those places are having to review their policies and practice against new requirements, although potential changes do need to be assessed within the framework of economic viability. These pressures are already being felt at all the interfaces between companies and the public, including the critical area of the portfolios of investment funds.

The overall effect of all these changes is that legislation and planning conditions are becoming more stringent or that requirements already in place, but not fully implemented, are being applied more vigorously. The fact that activities, installations, or pipelines associated with natural gas industries have been permitted in the past does not ensure that future projects will automatically receive approval.

The gas industry has a long experience of ensuring that any negative impact of its operations on the environment is kept to a minimum. Attention to environmental protection during exploration and production activities has placed special emphasis on the control of gaseous emissions includes hydrogen sulphide, the protection of water quality, appropriate disposal of drilling muds, minimisation of land use and on occasion the reduction of the number of sites or offshore rigs through the use of special drilling techniques. International conventions and legislation are tightening those requirements even further. Increased attention is being focussed too on environmental performance in more remote locations such as rain forests and tundra.

Even for conventional developments in those areas that have already been exposed to environmental control procedures it will still be necessary to give detailed attention to the environmental aspects. Examples of such developments in Europe are plans for the construction of LNG terminals in several countries e.g. in Greece, Turkey and Portugal all of which are noted for their scenic coasts. Some analysts have cautioned that the planned building of an LNG terminal(7) at Setubal, south of Lisbon, and the laying of a 290 kM pipeline along the Atlantic coast could result in protests over scenic issues. In Italy proposals to modify an LNG site have allegedly stimulated the local authority to try and close it because the locality has touristic interest which in many ways is a more immediate source of revenue.

In the past it was often sufficient to reinstate pipeline routes to the satisfaction of the landowner; that in effect often meant reinstatement as grazing or arable land. Usually there was little deviation in the route to break the visual aspect of any variation in ground cover. Nowadays that approach is no longer sufficient because there are pressures to seek ways of reinstating the original habitats. As a result salt marshes, heathlands and other sites of special interest may require additional work to ensure permission for a throughway; that can require several years of periodic attention to ensure success. Each project has its own areas of sensitivity. Last year a proposal by a French-Spanish consortium to link Lacq with Serrablo through the Lescum, Anso and Hecho valleys in the Pyrenees aroused fierce controversy not only from local inhabitants, but also from national and international bodies because of fears expressed on behalf of brown bears and wild bird conservation areas(8). The proposed laying of further pipelines between Canada and the USA has also generated some opposition.

Similar if less demanding constraints have of course been specified in the past in many countries and the planners, engineers and environmental experts cooperated successfully to minimise the potential impacts of developments and ensure that the projects were completed.

NATURAL GAS AND GLOBAL WARMING

Methane from Fossil Fuel

The issue of global warming has recently stimulated the desire for an increased use of natural gas but at the same time it has focussed attention on the benefits of effective emission control within the industry.

There is no argument that natural gas is, overall, the cleanest fossil fuel in use nor is it disputed that, per unit of energy input, it produces less carbon dioxide than oil or coal. Nowadays, however, the overall effect of fuel use is considered in much more detail. One aspect of that is the attention drawn to the fact that the major component of natural gas is methane and, as it too is a greenhouse gas, any emission of natural gas would contribute to global warming. If there was a significant emission of natural gas then some of its advantage, in terms of its relatively lower carbon dioxide emissions, could be reduced.

The effectiveness of different molecules in contributing to the greenhouse effect varies; the relative factors depend on the absorption spectra of the trace gases and their concentration in the atmosphere. The absorption of heat by carbon dioxide only increases logarithmically with increasing concentration, methane absorption increases as the square root of concentration and absorption by CFCs is proportional to concentration.

As a result the trace gases have different efficiencies as greenhouse gases. For instance the methane is said to be 21 times more efficient than carbon dioxide as a greenhouse gas. However there are other factors to be taken into account. One of these is the lifetime of the species which depends on the processes which result in its removal from the atmosphere. Carbon dioxide is removed by several mechanisms so there is a mixture of several lifetimes to be considered between 7 and 300 years. Methane, with an atmospheric lifetime of ten years is removed by reaction with hydroxyl radicals. The reactions form ozone in the process and also some water in the stratosphere where it is an important greenhouse gas. Because of different lifetimes the contribution of a 1kg release of a trace gas depends on the time period considered. Some values based on the release of 1kg of each are shown above in Table 4. On a molecule to molecule basis, rather than a weight basis, the ratios for methane to carbon dioxide are 23, 7.6 and 3.2 for 20, 100 and 500 years respectively.

TABLE 4 GLOBAL WARMING POTENTIAL RELATIVE TO CO_2 (1 KG EMISSION)

Trace Gas	Time horizon		
	20yr	100 yr	500 yr
Carbon dioxide	1	1	1
Methane (including indirect)	63	21	9
Nitrous oxide	270	290	190
CFC-11	4500	3500	1500
CFC-12	7100	7300	4500
HCFC-22	4100	1500	510

These considerations take into account both the direct effects of any methane released and also indirect effects from the carbon dioxide, ozone and stratospheric water formed when the methane is oxidised. If we consider carbon dioxide, methane, nitrous oxide and chlorofluorocarbons the relative contributions to the greenhouse effect over the past decade have been 55%, 15%, 6% and 24%.

Estimates have been made of the total annual emissions of methane from all sources and those that arise from fossil fuels. It is reported that of about 450 million tonnes annually 45 million tonnes of methane arises from the petroleum and natural gas industries and 35 million tonnes are released from coal mining. So we could consider the methane emissions associated with the oil and natural gas industries contribute about 1.5% of the effect attributed to these four trace gases.

The important point to grasp, as far as natural gas supply is concerned, is that emissions of methane in any natural gas release contribute to global warming and need to be minimised. That point is frequently raised nowadays when the environmental effects of fossil fuels are discussed.

There is some consensus on the estimates of natural gas releases world wide, but limited studies on carbon isotopes have suggested that emissions from fossil fuels could be larger than the estimate of around 80 million tonnes per year given above. Thus one can expect further studies on the emission inventories.

Potential sources of methane emissions are venting or leakage during exploration or production of oil or gas, or at the various stages of the natural gas supply system. Hard data, as opposed to estimates, are difficult to come by and both oil companies and gas companies are seeking ways in which more precise estimates can be achieved.

There have been indications (9) that emissions of nitrogen oxides and carbon monoxide are also relevant to the total global warming impact of fossil fuels and should be included in comparisons.

Efficiency

The debate on the greenhouse effect has emphasised the desirability of increased efficiency and conservation. One large potential market for natural gas is in power generation. It is most efficiently carried out in combined cycle systems, where gas drives a turbine to generate electricity. The waste heat produced is used and supplemented to drive a steam turbine which generates further electricity thus maximising the use of the original gas input and enhancing the efficiency of the process. The carbon dioxide emission is effectively halved compared to that from a conventional coal plant.

In the USA 15% of natural gas is used for electricity generation; that is equivalent to 10% of the fuel used in the power stations. It is estimated that the market could double by the end of the decade. In Europe similar developments are anticipated and the EC has produced draft legislation that would remove legal barriers to expansion of natural gas for power generation. The Netherlands has for many years used natural gas to fire much of its power plant although there is a planned increase in the use of other fuels to diversify its supply. One consultancy firm has predicted that in 18 countries of western Europe and Scandinavia the use of gas in power stations could double to account for 11.6% of power station fuel. Examples of the estimated increases by the year 2005 for the UK, W. Germany, Belgium and Spain are 12.2%, 15.3%, 18.6% and 10.2% compared to 1988 figures of zero, 6.3%, 4.9% and 3%.

The natural gas supply for these power stations would come from the transmission supply system and would not entail any related methane emission apart from any associated with the production processes. The increased use of natural gas in markets such as power generation may lead to lower emissions of pollutants other than sulphur dioxide.

It is not just the generation of electricity which is stimulating the requirement for additional supply. There is also a resurgence of interest in the use of natural gas to improve the quality of urban air in many areas of the world. For some it is a new venture with the installation of new systems which are effectively leakage free. For others it may require upgrading systems that are already in place. This action will ensure that leakage of natural gas does not detract from the enormous benefits achieved in reducing other pollutants nor will it affect the high efficiencies achieved in the point of use applications.

Vehicle emissions will continue to make a dominant contribution to urban pollution for some time to come and here too natural gas may play a role. With the development of suitable supply systems fleet transport fuelled with natural gas may help to reduce the pollution burden. It is a development of course in which Canada has taken a leading role.

ENSURING SUCCESS

The challenge of contributing to the improvement of ambient air quality through the supply and use of natural gas, whilst complying with continuously evolving views on environmental protection, will remain but it is not insurmountable. The experience of the past is that a combination of timely consultation with local communities and interested bodies, effective engineering and design, good will and some flexibility provides an acceptable solution in the majority of projects. It is essential to try and ensure that discussions are harmonious, because many developments do not benefit the immediate locality to a great degree in terms of employment.

Perhaps one extra ingredient is necessary to-day. It is the education of staff, from the Chairman down to sharp end operatives, on the relevance and importance of the different environmental issues impinging on the supply or use of natural gas. For some specialists it will also require an increased understanding of the science so that they are equipped to inform others and to debate the claims and counter claims made with respect to the natural gas industry.

One of the important aspects about improving pollution control is the question of cost effectiveness. In Eastern Europe, in which natural gas supply should play its part in pollution abatement, an interesting situation may arise. Investment there is likely to improve the air quality in neighbouring States of Western Europe more economically than might be achieved by the installation of further control measures in those States themselves.

CONCLUSIONS

The properties of natural gas make it a favoured fuel in the face of unabated concern about local, international and global environmental issues. Emphasis on these issues is unlikely to decrease in any region of the world and the implementation of high standards of environmental protection will require good understanding, commitment and implementation at all levels of gas organisations.

The opportunities for increased supply to energy efficient applications, whether power stations using combined cycle gas turbines or new distribution systems in urban areas, will help to abate greenhouse gas emissions as well as those of conventional pollutants. The present concern on emissions of natural gas itself needed to be addressed in order to ensure that unfounded or unbalanced views on their magnitude and effects do not go unchallenged.

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THE ENVIRONMENTAL CHALLENGE

The Impact of Environmental Policies on Global Demand for Refined Petroleum Products

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THE ENVIRONMENTAL CHALLENGE

THE IMPACT OF ENVIRONMENTAL POLICIES ON GLOBAL DEMAND FOR REFINED PETROLEUM PRODUCTS

Presented by

Robert G. Skinner
Director, Long-Term Co-operation and Policy Analysis
International Energy Agency, OECD
Paris, France

NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
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Good afternoon. I do not know who to blame for my being here today, but I must thank the Canadian Energy Research Institute for its hospitality and for putting together a programme that is both comprehensive and timely in every respect.

The themes for this year's programme are all interconnected. Today's World Oil Market situation reminds us that oil is essential and, whether we need the lesson again or not, essentially political. In dealing with the evolution of this crisis we are encountering, among other problems, environment-related bottle-necks in some refined product markets. The Soviet Union's relevance to the crisis and the environment is obvious. Its capacity to continue to export oil, so financially critical to its own fragile internal situation, compounds its importance to world crude oil markets. This winter, Soviet gas and oil exports will be watched by everyone. Over the longer term, the Soviet Union's vast gas resources will surely be significant in easing their own and western Europe's emissions of greenhouse gases. As for the North American theme, perhaps nowhere else more than on this continent does the future role of natural gas bring together energy security and environmental concerns.

These are the big issues. I have been asked to address the more specific, but no less complicated subject of what environmental policies are likely to do to the global demand for refined petroleum products.

In the time available to me, I want to:

- summarise the IEA's World energy outlook concentrating on petroleum products;
- identify where I see the major environmental pressure points on the product barrel, and
- present for discussion some of the issues or concerns that I think these might raise.

Global Energy Outlook

The IEA continuously assesses global energy markets. Under varying assumptions of crude oil prices, growth in population and GNP and other factors, we try to project World Energy Demand ten to fifteen years into the future. These are intended to be only indicative, not predictive.

Our most recent projection assumes that prices rise from a 1991 price of $23 (in 1990 dollars) to $35 by 2000 then flat thereafter to 2005. Clearly this assumes that the current price of ($30) will settle out to $23 next year. World oil demand continues to grow at 1.7 per cent per annum or a little over 1 million barrels of oil per day. Table I shows the expected rates of crude oil demand growth by region in the World from 1988 to 2005 and, for comparison, from 1973 to 1988. Table II shows where we think the greatest growth will take place for some of the main refined products.

Table I
World Oil Consumption (%)

	Average Annual Change (%)		
	1973-88	1983-88	1988-2005
OECD	-0.8	1.6	0.8
Central/Eastern Europe[1]	1.9	-0.1	1.5
Developing Countries	4.1	3.6	3.3
TOTAL	0.7	1.8	1.7

Crude Oil Consumption by Region
(Mb/d) and [share - %][2]

	1988	1995	2000	2005
OECD				
North America	19.2 [52]	19.6	19.4	20.2 [48]
Western Europe	12.5 [34]	14.0	13.9	14.5 [34]
Pacific	5.5 [15]	6.8	7.1	7.5 [18]
TOTAL OECD	37.2 [57]	40.4	40.3	42.2 [49]
Central and Eastern Europe	11.3 [17]	12.0	12.9	14.2 [17]
Developing Countries	16.5 [25]	22.3	26.3	29.0 [34]
	65.0	74.6	79.5	85.4

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[1] Includes the Soviet Union.

[2] May not sum to 100 due to rounding.

Table II
PETROLEUM PRODUCT GROWTH BY REGION
(Mb/d)

	1988	1995	2000	2005
OECD				
Gasoline	11.8	12.7	12.7	13.2
Kerosene	3.1	3.4	3.7	4.2
Gas/Diesel Oil	8.9	10.4	10.5	11.1
Heavy Fuel Oil	4.2	4.0	3.5	3.2
- for power generation	2.1	2.2	2.0	1.8
Other Products	9.1	9.9	10.0	10.6
Total	**37.2**	**40.4**	**40.3**	**42.2**
USSR/E.Eu				
Gasoline	2.4	2.9	3.1	3.4
Kerosene	0.9	1.0	1.2	1.4
Gas/Diesel Oil	2.1	2.7	2.9	3.3
Heavy Fuel Oil	3.3	2.9	3.0	2.9
- for power generation	1.8	1.2	1.3	1.1
Other Products	2.5	2.6	2.6	3.3
Total	**11.3**	**12.0**	**12.9**	**14.2**
LDCs				
Gasoline	2.9	3.6	4.6	5.6
Kerosene	1.4	2.1	2.6	2.8
Gas/Diesel Oil	4.3	5.9	7.4	8.3
Heavy Fuel Oil	4.0	5.6	5.8	5.8
- for power generation	1.7	2.8	2.9	2.8
Other Products	3.4	4.3	5.0	5.9
Total	**16.0**	**21.5**	**25.4**	**28.3**
TOTAL				
Gasoline	17.1	19.2	20.4	22.2
Kerosene	5.4	6.5	7.4	8.4
Gas/Diesel Oil	15.4	18.9	20.8	22.7
Heavy Fuel Oil	11.6	12.5	12.3	11.8
- for power generation	5.6	6.3	6.2	5.7
Other Products	15.1	16.8	17.6	19.8
Total	**64.5**	**73.9**	**78.6**	**84.8**

North American oil demand is expected to grow very little - only 5 per cent over the period. OECD Europe's demand grows more, 16 per cent, double North America's in volumetric terms. The growth in OECD Pacific oil demand is expected to exceed 35 per cent over this period. (Total OECD growth is about 13 per cent, 37.2 MBD to 42.2 MBD.) So, if world demand is increasing about 1 MBD each year, the projected 5 MBD growth in the OECD over the next 15 years accounts for only 25 per cent of the total growth. However, since the OECD region has the most extensive environmental requirements and the organization and policy concerns to increase those requirements, it will continue to dominate the environmental influence on refined products, as its share of total demand declines.

Less Developed Countries increase their use of oil 75 per cent from 16.5 MBD to nearly 29 MBD. Their consumption of gasoline, kerosene and gas/diesel-oil each nearly doubles while heavy fuel oil increases by 45 per cent with much of this for power generation especially over the shorter term. But after 2000, HFO declines as natural gas begins to play a much larger role in power generation in some LDC's.

The Middle East's oil consumption increases by nearly 175 per cent mainly in gas/diesel oil and gasoline in response to a near quadrupling in the car park by 2000. For example, the fact that 45 per cent of the population in Saudi Arabia, is under 15 years of age speaks for itself. The combination of youth, its geography, and relatively high per capita income is a potent formula to spur transport fuel demand. Latin American oil demand is not expected to grow as much but will still be more than 35 per cent higher than at present. At the product level, the greatest growth will be in gas/oil and HFO, especially in power generation. Asian demand (excludes China) for petroleum products, led by gas/diesel oil and kerosene, will see its overall growth for oil increase by 72 per cent by 2005. China is expected to have comparable growth, with gasoline, gas/diesel oil and other specialty products driving the growth. Over the next decade, Africa's oil demand is expected to be slower than over the past ten years as this region continues to struggle under the burden of poverty and political instability. Among products in Africa, gasoline demand is expected to show the fastest growth at about 5 per cent per year.

What about the Soviet Union and Eastern Europe? The outlook for this region is uncertain at best. Some countries will grow faster than others. But, when talking about Central Europe, it must be remembered that their combined current oil consumption, actually dropping as their economies go into neutral, is only slightly larger than Canada's; about 2 million barrels per day. Including the Soviet Union, their oil demand might increase from 11.3 MBD to over 14 MBD or 26 per cent. Here, the pressure will be on light products. We see their use of HFO continuing to decline, especially in power generation, as they push even more gas under boilers. As in the west over the past two decades, this region's demand for light products will whiten the product barrel and they will need to add conversion capacity to do so.

Where will the new capacity be needed? If the markets in the industrialized areas are not going to grow much and siting for new grass roots refineries continues to be difficult, and the growth in demand takes place in areas like Eastern Europe, the Middle East and the Far East, then these areas should logically attract the refining investments.

No full-scale refinery has been built in the United States in almost two decades, and most observers think environmental (including siting) and economic constraints will continue that trend for the foreseeable future.

Looking offshore, but close to home, Caribbean refining may not offer a major increment to fill a potential demand gap either. It would take billions of dollars and more than a decade to upgrade most Caribbean refineries to U.S. standards. Coastal Corp.'s plans to re-open the 50-year old refinery it bought last year in Aruba will provide an interesting, and very current, indication of some of the costs, problems and limitations -- but also the promise -- for expansion in that area.

Returning to the areas I mentioned -- Eastern Europe, the Middle East and the Far East -- these require a separate consideration of the circumstances in each region. For the latter two, where capital investment decisions are made to expand capacity nearer the source of certain crudes, it is not unreasonable to assume that these would be modern plants that can handle a range of crudes and produce a high-quality product stream including premium unleaded grades for export.

Eastern Europe is already heavily influenced by the umbrella of the U.N. Economic Commission for Europe (UNECE), the EFTA and the European Community, not to mention the OECD. East Germany will, of course, make its transition to the West abruptly on Oct. 3. Hungary, Czechoslovakia, Yugoslavia, Austria and Italy created a new association on July 31 in Venice to deal with pressing regional issues (the "Pentagonale"), with transport policy and vehicle-related pollution specifically included on the list of priority topics for action.

With the European Community adopting the equivalent of U.S. vehicle pollution standards and Western auto manufacturers scurrying to acquire or buy into East European production, it is inconceivable that those countries would continue to operate with an absence of environmental standards in the production and consumption of fuels. Their proximity to Western countries that have now collectively joined the anti-pollution fraternity, their interest in joining (and benefitting from) the European economic expansion, and the dominant environmental sentiment within their own new multi-party systems all argue for a rapid change in attitude toward fuel quality and emissions controls. While those factors add hefty up-front expenses to an already massive demand for modernization and capital infusion, their people are demanding a new approach to the environment as they aspire to a Western European quality of life.

This has been a very quick and superficial look at the long-term future. We expect to soon publish the details of the World energy outlook. I acknowledge that some of these projections may be hard to reconcile with the price increases generated by the current crisis in the Gulf. In our outlook we see oil prices firming relatively early in the 15-year period due to a squeezing of supply and demand, quite apart from today's events. There will be short-term economic repercussions from the crisis - very serious for some developing countries especially. But, potential for efficiency gains exist; price shocks tend to re-kindle interest in efficiency, and I do not see why that will not happen this time, with the one observation, that our economies' reliance on oil today is far less than it was in 1973 and 1978/79. And where oil's role is solidly entrenched, i.e. transportation, a quick and lasting demand reduction is unlikely. It takes a decade or more to roll over the stock of vehicles, and the cars to come are already on the design tables. That being said, over the medium-term we expect that crude oil producers can and will develop supply to meet the demand in the market. Unlike in the previous crises, where Official Government Selling Prices determined the market, today there is considerable scope for a fall-back of prices.

This outlook incorporates the effects of most conventional environmental policies that are in train now. We have not speculated on the policy responses of governments, for example, to the issue of global climate change. I will offer my speculations on that issue below.

Some of the key points in this picture for refiners might be:

- The overall product barrel in the OECD region continues to whiten, but not as much as it has since 1971. Outside the OECD, starting from a blacker base, the rate of 'whitening' is more dramatic.
- OECD oil demand grows slower than the rest of the world's but continues to grow for transport fuels.
- The OECD region's share of oil consumption falls below 50 per cent of the world's total.
- While there will be moves to burn HFO in power generation in places outside the OECD, this will give way to natural gas, suggesting continuing additions to refinery conversion capacity. This will most likely occur where the growth in demand is greatest - i.e. outside the OECD.

Now, against this overview, where are the environmental pressure points on the product barrel?

When I lower my focus to the product-by-product level of environmental pressures and then attempt to do this country-by-country or even regionally, the details confuse, and I see conflicting signals for the effects on demand. Environmental pressures are basically those that I would call 'current' and those 'possibly to come'. The table below illustrates some of these.

Table III
Environmental Pressures on Refined Petroleum Products

Product	Now	Possibly to Come
Gasoline	• Lead phase-out • RVP reduction • Alternative fuels • Reformulated gasoline • Tailpipe emissions reductions - VOC - NO$_x$ reduction - CO reduction	• 'Environmental' taxes • Efficiency drive - more traffic management • Air 'toxics' or potentially hazardous air pollutants (EPA's 119)[1]
Diesel	• Particulates • Sulphur	• Aromatics
LFO/HFO	• Sulphur • Particulates	• Aromatics? and 'toxics'
Other Products	• Aromatics • Lube Oil disposal/re-refining • Recycling	

This is certainly an incomplete and highly generalized list. For example, in petrochemicals, environmental pressures are already affecting the nature of consumer demand and the specifications for many products. The growing popularity of recycling, which is driven by rising land costs, land-use and other environmental concerns, will go back on virgin product sales. This applies to plastics recycling being investigated in the U.S. Meanwhile, plastics do not make-up the bulk of garbage as recently revealed by some careful archaeological excavations of landfill sites in the U.S.! The bulk of garbage in landfill sites is paper . . . probably forecasts! I do not believe that recycling will significantly affect the size of the petrochemical industry, but it will impose new costs including special quality control and labelling challenges, and these in turn could lead to structural changes in the industry as it goes through its inevitable cycles.

There are other feed-back effects. Reducing volatility (presumably) requires less crude - more molecules get to the cylinder heads for combustion rather than evaporating. But there are energy penalties in reducing the volatility of gasoline. The production of unleaded gasoline can have a 1-2 per cent refining energy penalty. On the other hand, the addition of oxygenates to boost octane, will marginally relieve pressure on crude oil demand, to the extent these are derived from natural gas or other non-crude sources. This is also true for some components of reformulated gasoline. And, finally, alternative fuels like CNG and methanol will replace demand otherwise met out of the crude oil barrel. So, there will be both non-crude derived add-ons to and increased losses from the overall input barrel.

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[1] The U.S. EPA has identified a list of 119 hazardous or potentially hazardous air pollutants, many of which derive from the petroleum sector.

But, while in and of themselves they may drive up costs and cause investment problems for the industry, I do not think that these 'puts and takes' in the refining system will significantly affect the volume of crude oil demand, nor greatly alter the complexion of the product barrel.

What is of greater interest, in my view, is the cost of these changes and where these costs end-up. Assuming that these can be passed on to the consumer, it remains to be seen whether they will be significant enough to noticeably ease gasoline demand. What effects these financial and investment factors will have on competition will be the subject of increasing debate, especially in North America. The Trade Effects of markedly different quality specifications between continents will influence where investments go, and affect future product flows. But in the end, it is most likely that crude oil price increases and taxes (whether for environmental or fiscal reasons) because they are felt relatively quickly by the consumer will have a greater effect on demand than will environmental regulations. To give some perspective to why I believe this to be so, it is estimated that the North American refining industry will have to spend $30 billion over the next 10 years to meet the new fuel requirements in the U.S. Clean Air Act. This is equivalent to 2c/gallon on U.S. transportation fuels consumed over the period, which is less than what the World has paid-out for the increase in crude oil prices since August 2.

The problem masked by these large, industry-wide costs spread over very large volumes is that somewhere the industry has to see this business as an attractive investment. The North American refining business for example, surely must be seeing a set of conflicting signals on which to base its future investments.

- apart from filling the gap left by Europe's retention of previously exported gasoline to North America, North American refiners probably see a stagnant or only slightly growing demand for refined products. (It is price changes and new car registrations that drive gasoline demand: Can Americans possibly own and drive more cars?);
- an aging, accident-prone refinery system working at capacity (93 per cent last month);
- even without capacity additions, capital needed to:
    - meet, as yet uncertain, environmental (almost pharmaceutical-like) fuels specs,
    - refurbish aged and accident-prone equipment (eg. in-ground tanks)
    - meet escalating insurance premiums for environmental risks;
    - greater pressure to meet local safety and operational restrictions.

And environmental policies affect the industry other than within the refinery fence, for example:

- older tanker fleet than World average; increasing imports; stricter tanker design and loading restrictions; contingency equipment costs and loose-ended liability obligations.

They all add up to incremental costs while the size of the market is not increasing. In other words, *spending more to stand still.*

The good news might be that with higher priced products come higher margins. Also, refiners will increasingly try to keep margins up by trimming inventories. For some players, larger market share could come from the departure of others (not good news for those who leave!). This is where the present crisis may have some bearing. Even before the increase in crude oil prices, the small refiners in the U. S. were expressing concerns about meeting the new fuel specifications and other environmental requirements. The new infusion of cash from the crisis to the integrated companies better positions them to meet rising environmental costs. On a broader level, should sustained higher oil prices stall economies or worse, the capacity of key, oil-related sectors such as the automobile and petrochemical industries to meet their own growing environmental pressures could be weakened. For, as we have come to realise, the environment is best served during periods of economic growth.

At a more micro level, a crude oil price rise together with the tax effect opens up diesel/gasoline differentials at the pump sending a signal to consumers for their future vehicle purchases. This, together with diesel's better performance on Greenhouse Gas Emissions on a full fuel cycle basis, potentially shifts the future environmental focus to particulates, sulphur levels and aromatics in diesel - a different set of problems than RVP in gasoline.

Probably the most significant impact on the petroleum product barrel over the long term will come from responses to the issue of global warming. In most industrialised countries the transportation sector, essentially the private automobile, is one of the principal (and growing) sources of greenhouse gases. In the OECD, Transport's share of CO_2 emissions rose from 22 per cent to 28 per cent in the last fifteen years at the same time that its share of oil consumption roce from 49 per cent to 67 per cent. Thus the transport sector will be a key target area for policy responses in the context of global climate warming. This issue, together with health and traffic-management policies at the urban level, will see increased energy efficiency and more alternative transport fuels and will thereby influence future gasoline and diesel demand. Efficiency and fuel switching were significant factors in reducing our use of the heavy end of the barrel since 1973. Now we have all the oil security reasons of the past 15 years together with compelling urban health and transportation pressures and the obvious linkage between reduced energy use and reduced greenhouse emissions to accelerate efficiency policies and programmes to reduce our use of the lighter end of the barrel.

The Greenhouse issue has already prompted some of the IEA's member governments to launch policies to reduce emissions. While on close scrutiny some countries are actually doing less than might appear, the policies being contemplated range from taxes to regulations, standards and traffic management schemes, information programmes, grants and subsidies -- basically the full spectrum of policy instruments used to reduce oil dependency in the seventies. The effects of this renewed drive to use less energy will be first felt in the industrialized countries. In the developing countries and Eastern Europe any efficiency gains, will be masked by their pent-up demand for oil. For one thing, their automobile ownership is, on average, one quarter and, in the USSR, 1/10 and more of what it is in the U.S. or West Germany. A growth in demand in these markets for even the most efficient cars will see growth in gasoline demand. [What would you do if you just bought a new car and the road led to the beaches of Spain?]

The IEA is assessing the impact of different policies on reducing greenhouse gas emissions. We have, for example, taken a preliminary look at carbon taxes. The effect of an OECD-wide $50 a ton coal equivalent carbon tax would result in a 20 per cent increase in the OECD's energy prices (in 1989; 1986 dollars). Coal's price would double, oil's would increase by $8/bbl and the price of natural gas would go up about $1.10/mcf. Energy demand would be significantly reduced (9 per cent), while shifting the relative competitiveness among fuels. Coal would be hit hardest (-25 per cent) replaced by HFO and natural gas, then demand would shift off HFO later on. The impact on other petroleum products would vary. Diesel would be affected most, primarily as a result of the reduced road transport of goods with shifts to rail and other modes where available.

What would this give you in terms of CO_2 reductions, bearing in mind that this is a little less than the crude oil price increase since August? It would only slow-down the rate of growth of energy-related CO_2 emissions in OECD countries from 1.2 per cent to .6 per cent per year over the period to 2005. So, rather than rising 25 per cent in our reference case, CO_2 emissions would increase 13 per cent. This is not even close to the stabilization advocated by many and already embraced by several OECD countries. A $50 carbon tax in the OECD would only reduce the World's CO_2 emissions by about 5 per cent. As for concentrations over the very long-term, such an OECD carbon tax would reduce concentrations in 2050 .7 to 1.1 per cent depending on GDP growth rates - essentially insignificant.

This is a fairly theoretical projection, but it gives one a sense of scale of what would be required to significantly reduce greenhouse emissions. It also underscores the futility of "*go-it-alone*" strategies, even on the regional scale of the OECD.

Conclusion

Given this brief overview, what conclusions can be drawn? I offer the following:

- The growth in World demand for refined petroleum products will be largely outside North America.
- Some regions, especially the Far East, Eastern Europe and the Soviet Union, will require greater refinery investments to meet lighter product slates and, to the extent that these and other regions want to export products to the OECD region, they will have to meet the latter's, more strict, environmental and health specifications.
- While specific environmental requirements in and of themselves will likely not have a major volumetric influence on demand, refining and supplying transportation fuels will be increasingly complicated and costly. However, these costs, together with environmental and other taxes on fuels, and renewed emphasis on efficiency will likely dampen demand, but probably not as much as will higher oil prices.
- Some of the side effects of environmental regulations will be to influence product trade patterns and could accentuate concentration in some markets.
- International responses to global warming, while potentially important in reducing oil consumption, are probably not the most immediate concern for the petroleum refining business.

WORLD OUTLOOK - KEY FEATURES

- WORLD PRODUCT BARREL CONTINUES TO WHITEN
    - TRANSPORT FUEL-DOMINATED
- OECD'S SHARE DROPS BELOW 50%
- GROWTH IN MIDDLE EAST, FAR EAST, EASTERN EUROPE
- NATURAL GAS WILL PUSH AT HEAVIER END

ENVIRONMENTAL POLICIES AND PETROLEUM PRODUCTS

- **WORLD ENERGY OUTLOOK**
  - **WHERE IS THE FUTURE GROWTH?**

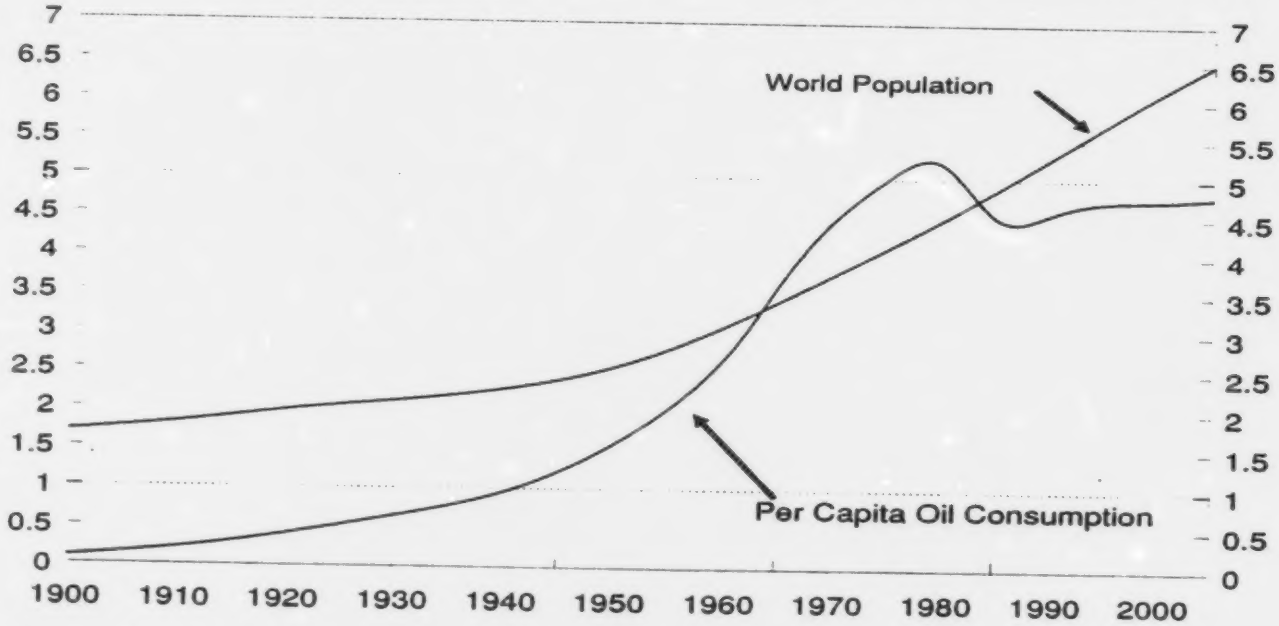
- **GREEN PRESSURE POINTS ON THE BARREL**

- **ISSUES AND IMPLICATIONS**

WORLD PRIMARY ENERGY REQUIREMENTS
(%)

	AVG. ANNUAL CHG. (%)		FUEL SHARE (%)	
	1973-88	1988-2005	1988	2005
OIL	0.7	1.7	39	35
NATURAL GAS	3.3	3.6	20	25
SOLID FUELS	2.9	2.1	29	28
NUCLEAR	16.0	2.5	5	6
HYDRO, ETC.	3.4	3.0	6	7
TOTAL	2.2	2.3	100	100

World Oil Consumption (bbls/person/year)



(population in billions and consumption
in bbls/person/year)

NORTH AMERICAN REFINING
- THE FUTURE?

- STAGNANT TO SLIGHT GROWTH IN PRODUCT DEMAND
- AGING, ACCIDENT-PRONE INFRASTRUCTURE
- CAPACITY TRIMMED TO MAXIMUM (93%)
- INCREASING CAPITAL DEMANDS FOR NON-CAPACITY PRESSURES
    - ENVIRONMENTAL/HEALTH SPECIFICATIONS
    - REFURBISHMENT
    - INSURANCE
    - LOCAL REGULATIONS

- AND OUTSIDE REFINERY FENCE . . .

- TANKERS
    - OLDER THAN WORLD AVERAGE
    - INCREASINGLY STRINGENT DESIGN, LOADING, CONTINGENCY REQUIREMENTS
    - LIABILITY QUESTIONS

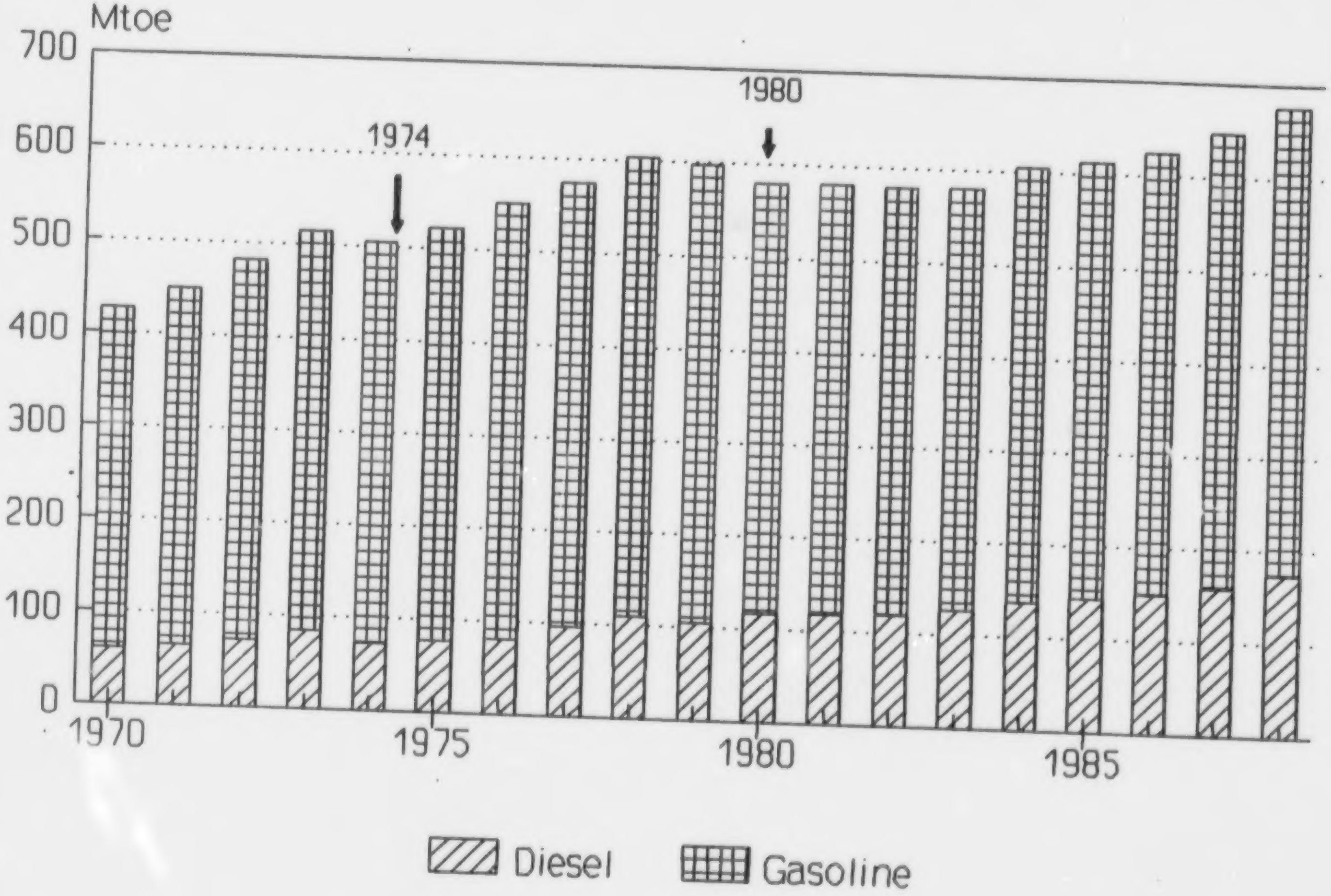
SPENDING MORE TO STAND STILL?

- HIGHER VALUE PRODUCTS: HIGHER MARGINS?
- TIGHTER PRODUCT INVENTORY CONTROL
- STRUCTURAL CHANGE - STRAIN TOO GREAT ON SOME?
- TRADE IMPLICATIONS

GLOBAL WARMING

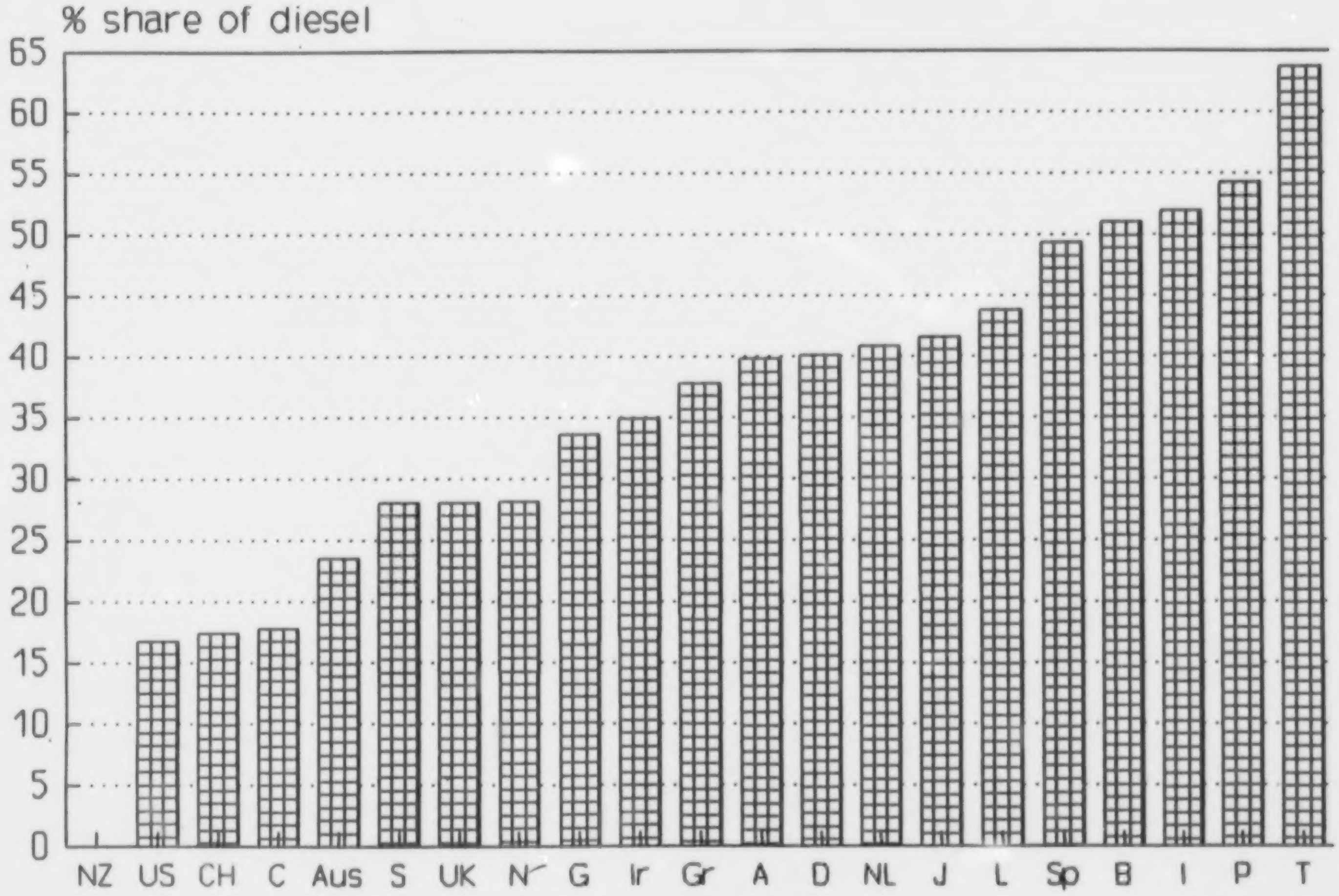
- ALL ABOUT ELECTRICITY AND TRANSPORT
- THE TRANSPORT BARREL UNDER PRESSURE
  - EFFICIENCY
  - URBAN TRAFFIC MANAGEMENT
  - DIESEL/GASOLINE SHIFT?
  - PRICES

Oil Demand for Road Transport in the IEA, 1970-1988



Source: IEA, 1990.

Share of Diesel in Road Transport in IEA Member Countries in 1988



Source: IEA, 1990

SOME ISSUES

- GASOLINE/DIESEL RATIOS - GREENHOUSE RESPONSE
- INTERREGIONAL FLOWS OF PRODUCTS
- INVENTORY FLEXIBILITY
- INCREASING PRODUCT EXPORTS - A SECURITY ISSUE?
- LESSONS TODAY?

SUMMARY

- GROWTH IN RPP YES, BUT OUTSIDE TRADITIONAL AREAS

- INVESTMENTS IN OECD TO MEET QUALITY AND OTHER GOALS

  - OUTSIDE TO MEET QUANTITY, BUT, IF MARKET IN OECD, QUALITY TOO

- PRICE, TAXES, EFFICIENCY PROGRAMMES, TRAFFIC MANAGEMENT

  - MAIN PRESSURES ON PRODUCT BARREL

- GLOBAL WARMING IS THE LEAST OF THE 'HEATS' ON REFINERS

EFFECT ON ENERGY CONSUMPTION OF IMPOSITION OF CARBON TAX IN OECD AT $50/TCE FROM 1990

(IN % DEVIATION FROM BASE CONSUMPTION)

	1995	2005
Hard Coal		
Industry*	- 46.0	- 53.1
Power Generation	- 21.3	- 25.9
Coke	- 22.6	- 23.0
Total	- 22.9	- 27.8
* Excludes Coke		
Electricity		
Industry	- 5.3	- 5.8
"Domestic"	- 8.5	- 15.3
Total	- 7.2	- 11.5
Conventional		
Thermal Electricity	- 11.9	- 18.7

EFFECT ON ENERGY CONSUMPTION OF IMPOSITION OF CARBON TAX IN OECD AT $50/TCE FROM 1990

(IN % DEVIATION FROM BASE CONSUMPTION)

	1995	2005
Petroleum		
Gasoline	- 3.1	- 3.8
Diesel	- 5.1	- 7.2
Other Gas Oil	- 2.1	- 3.1
Heavy Fuel Oil	- 1.0	- 6.8
of which for Power Generation	+ 3.3	- 6.0
Total Petroleum	- 3.4	- 4.9
Natural Gas		
Industry	- 4.6	- 4.0
Power Generation	+ 9.0	+ 0.6
Other	- 5.6	- 6.3
Total	- 2.6	- 4.2
TPER	- 6.3	- 8.5

REDUCTION IN CO_2 EMISSIONS DUE TO OECD CARBON TAX
(IN % FROM REFERENCE CASE)

	1995	2005
North America	- 10.3	- 14.3
OECD Europe	- 5.9	- 6.8
OECD Pacific	- 9.1	- 13.3
OECD Total	- 8.7	- 11.7
World Total	- 3.6	- 4.4

THERE IS NO PREPARED PAPER FOR
ROBERTA NICHOLS WHO SPOKE ON
THE ENVIRONMENTAL CHALLENGE
PANEL

SOVIET OIL AND GAS:
RESERVE AND PRODUCTION POTENTIAL

Presented by

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NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

ABSTRACT

The Soviet Union is the world's largest producer of oil and gas, the largest exporter of gas and, over the last few years, has regularly swapped positions with Saudi Arabia as the leading exporter of oil. Despite these records, the Soviet oil industry has been faced with radically increasing costs in the last ten years, particularly in the last five years. It also appears that oil production in the USSR peaked in 1987-88 at 12.48 million barrels of oil (and condensate) per day.

While production costs have risen sharply, oil exploration costs have increased at a slower rate. It also appears that starting in the mid 1980s, annual additions to reserves failed to replace annual production of oil and condensate. The reserves that have been discovered over the last ten years have been largely found in small, distant, and high cost fields, which presage further increases in production costs.

Performance of the gas industry has been stellar over the last two decades, supported by production from the world's largest gas fields, located in the northern West Siberian basin. Annual production has grown at about 8% per year over the last 15 years, though that rate slowed in the late 1980s. In 1989, 28.1 trillion cubic feet were produced. While the costs of exploration and production in the Soviet gas industry have grown, the rate of increase has been a small fraction of the growth in oil costs.

Production of oil is forecast to decline throughout the 1990s, at an average rate between 1.5% to 3% per year, though the 1990 decline may be as high as 5%. Gas production is forecast to increase through the year 2000, reaching as much as 39 trillion cubic feet per year by the end of the decade.

SOVIET PETROLEUM OUTLOOK AND THE ROLE FOR FOREIGN ENTERPRISE

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NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
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I.

While the world watches with fascination as the crisis in the Gulf moves towards military confrontation, and while importing governments try to adjust to the loss of some 4.3 million barrels of oil per day, another crisis, of equal political and economic proportions, continues to play out.

That crisis is the dramatic collapse of the Soviet economy, the rejection of communism and the political disintegration of the Union of Soviet Socialist Republics.

Although President Bush conferred super-power status on the Soviet Union by the one-day summit in Helsinki, that status may be in name only. There is no basic commodity -- whether bread, meat, salt, tobacco, matches, soap or cooking oil -- which is not in short supply in the country. Often these items are not obtainable at all. The ruble, worthless outside the Soviet Union, is almost worthless within. Barter, the exchange of one good for another, more and more defines economic activity.

Scarce hard currency must be spent to meet the basic needs of the consumer. A few days ago we read about an agreement to import some 43 billion cigarettes, a stop-gap measure to reduce discontent. And we have learned that the Soviet Union has started importing gasoline for the first time since World War Two.

Agriculture is enjoying one of its best crop yields in history. Yet millions of tons of grain will rot in the field, will be lost or pilfered during transportation, to the extent that imports will again be necessary.

More disturbing is the recent news that, according to two respected Moscow weeklies, top military officers could be considering a coup to end the mounting economic and social disarray, and to restore old-style authoritarian rule.

Communism has failed. Now, the Soviet Union appears to be preparing to embark on a 500-day march towards a market economy. A march that will take them into high unemployment, bankruptcies, high inflation, bread lines and broad civil unrest.

II.

Much of the Soviet Union's wealth over the past years has come from the export of crude oil and petroleum products. The USSR -- then as it still is, the leading oil producer in the world -- was exporting as much as 30% of production, to take advantage of high world oil prices. When prices fell, export levels rose. These hard currency earnings were badly needed, for other than oil and natural gas, the country had very little to offer that the West would find attractive.

In retrospect, these oil-based earnings helped mask the spreading decay of the Soviet economy. Subsidized oil sales to Eastern Europe set aside their need to invest in a more efficient oil economy. Pay me now, or pay me later, the man on TV says. The bill has arrived, and is past due.

The oil industry of the Soviet Union today is in great difficulty. The peak in Soviet oil production came in 1987, at 12.48 million b/d. Oil exports that year totalled some 3.9 million b/d, allocated roughly equally between other Communist countries and buyers in the West. In the following year, 1988, production problems began to appear, and when the year was over, it was clear that the industry was in serious trouble.

In 1985 the Soviet Union was faced with a dilemma similar to that of today. Production of oil began falling in the third quarter of 1984, and within a year yields were down by some 480,000 b/d. Gorbachev rushed to Western Siberia, to personally exhort the workers to get the industry back on track. This concentration of attention worked and by the third quarter of 1986 production had been restored to earlier levels.

This time, however, there would be no personal intervention by Gorbachev, no additional funds or stepped-up equipment deliveries, or crews flown in from other oil regions. The country is exhausted economically, it can do nothing more to help.

When 1989 came to a close, output had declined some 340,000 b/d from the 1987 peak, but more importantly, the decline was accelerating. The loss in domestic production was also reflected in reduced oil exports, which fell to around 3.7 million b/d that year, from 4.1 million b/d in 1988.

Soviet statistics point toward a further loss of some 600,000 b/d in oil production this year, bringing domestic supply down to between 11.5 to 11.6 million b/d.

What is going wrong? Wells stand idle for lack of repair parts. Ethnic strife in Baku, the major source of oil field equipment, has sharply disrupted manufacturing. Pipelines burst because of initial poor construction practices and because regular inspection is being ignored. The dismantling of the nuclear power industry as a consequence of the Chernobyl nuclear accident has placed additional burdens on other forms of fuel for power generation, at a time when not only oil production is declining, but coal extraction is falling at a more rapid rate, and expansion in natural gas supply has been less than what had been hoped for.

The Soviet Union is benefitting from the higher oil prices, just as any exporter is benefitting. Unfortunately, it can place no additional oil in the market. Indeed, as domestic supply declines, the USSR must cut back on its oil exports if minimum requirements are to be met at home. In all probability, oil exports will be reduced by at least a further 10% in 1990, to between 3.3 to 3.4 million b/d, which likely will largely negate the earnings from higher oil prices.

If we accept the pessimistic judgment by Soviet oil officials that Tyumen oil production -- the heart of West Siberia -- may drop by as much as 1.9 million b/d by 1995, to which we would have to add further declines in the Urals-Volga and elsewhere, then we may want to think in terms of national oil output possibly not much greater than 10 million b/d that year.

That level of production -- 10 million b/d -- even with reduced demand at home because of reduced economic activity, would allow exports out of domestic supply at possibly no more than 1.5 million b/d.

I do not want to mislead you about the energy potential of the Soviet Union. The USSR clearly is the world leader in terms of natural gas reserves. The status of its oil reserves are more uncertain, simply because they have been a State secret since 1934. But a look at those areas still untouched by a drill bit must convince us that its energy potential is very real, and very large.

However, like an athlete who dissipated his potential early on, so has the Soviet Union been careless with its potential, through sheer mismanagement.

As you may know, the Tyumen oil fields of Western Siberia are the predominant supplier to the national economy. Tyumen oil is sold to the central government at a price of 23 rubles per ton. At the official exchange rate, that works out to be a bit more than $5 per barrel. At the tourist exchange rate, Tyumen receives the equivalent of around 53 cents per barrel. At the black market exchange rate, which probably more correctly reflects the true value of the ruble, the price of Tyumen oil to the central government would be around 21 cents per barrel.

No wonder, then, that oil exports have been so heavily emphasized in recent years.

The oil worker in Tyumen finally has realized that he has been "had" by Moscow. He has sold his oil "on the cheap" and has very little to show for it. Tyumen oil goes for 4 kopecks per liter. But the worker's wife, when she goes to the store, has to pay 5 kopecks for a liter of plain soda water.

A new purchase price of 60 rubles per ton has been set for 1991. But that is not enough. Pravda, the Communist Party newspaper, reports that the cost of production at the new deposits being brought into play -- deposits which are much smaller in size, with more complex geology and located in very remote regions -- will exceed that 60 rubles per ton.

What do the oil workers want, in addition to a more competitive price for their oil? They want no more than you or I would. They want better housing, better food supplies, more schools for their children, more hospitals. And they want some of the oil they produce for themselves, so that they can take this oil and sell it inside the Soviet Union, and abroad, and use the proceeds to benefit their life and their industry. How much are they asking for? Around 30%.

If the demands of the Tyumen oil worker are not met, then it appears they are prepared to consider a general strike.

III.

If your own means are limited, as they are for the Soviet Union -- and this means limited capital as well as outdated equipment and technology -- the natural recourse would be to look abroad for help.

As of the close of 1989, 1,274 joint ventures had been established in the Soviet Union. Of those, 143 were with US companies. But the financial exposure of those joint ventures is small. Roughly 60% have a charter capital of just up to 1 million rubles.

Why is the Soviet side so eager to establish joint ventures? Very simple. Think what a joint venture brings to the USSR:

advanced technology, managerial know-how, market contacts outside the country and, most important, access to hard currency. Indeed, there are far more Russians eager to establish joint ventures, because joint ventures, in their mind, will give them access to hard currency, to perks, to travel.

Despite the enthusiasm on both sides, joint ventures have not fared well at all. Probably no more than 20% of those registered are functioning in some manner. A great many simply have failed to get off the ground initially, or have gone bankrupt in the comparatively early days of operation.

Most potential partners never get beyond their first concern: How will the joint venture earn hard currency?

It is for that reason that joint ventures in oil production are enticing. Hard currency can be earned through the export of a portion of the crude produced. The key to ultimate success, however, will be found in what the USSR lays on the table. A deal in Eastern Siberia is not going to do it.

The best known joint venture to date of course is that which, when finalized, would give Chevron the right to develop the Tengiz oil field. Tengiz, a huge discovery located just east of the upper Caspian Sea, has been known to the Soviet Union for some time. But the characteristics of Tengiz -- the oil is deep-seated, under high pressure, with complex geology and a sulfur content exceeding 25% -- present a challenge beyond Soviet capability. Thus, the willingness to allow Western involvement in a field whose reserves may approach 20 billion barrels. Tengiz is the largest discovery in at least the last quarter-century.

Chevron negotiations date back some two and a half years, which gives you some indication that establishing a joint venture is an exceedingly complex -- and very trying -- process.

Ed Scott of Chevron, who has been closely involved in these negotiations, recently outlined the approval process, once all the documentation had been agreed upon. That approval list, working up from the bottom, included, among others: the local Oblast (a political-geographic entity within a Republic), local environmental groups, the local construction company, the Republic finance minister, the Republic planning ministry, the Republic council of ministers, the joint venture-proposed bank, the enterprises Ministry and the appropriate research institute, the Soviet foreign economic commission, the Ministry of Finance, the Ministry associated with the particular joint venture, the Ministry of Justice, the State Planning Committee and possibly the Supreme Soviet.

A number of developments came out of the recent visit to Moscow of a business delegation led by Secretary of Commerce Mosbacher. Amoco Eurasia Petroleum Co. signed a protocol with Gasprom which gives them an opportunity, after completion of a preliminary study, to then undertake a detailed analysis of the technical and economic feasibility of developing and producing several fields in Western Siberia.

Louisiana Land & Exploration came away with an agreement to provide training for Soviet geologists, geophysicists and engineers.

An agreement had earlier been reached with Elf, reportedly an oil exploration and production agreement, which will permit Elf to explore for oil in a large area to the north of the Caspian Sea.

Terms have been finalized under which Texaco will initiate a feasibility study covering oil and gas exploration and development in the Timano-Pechora region, in the Soviet North.

There is a role for oil service companies and equipment manufacturers. But payment will be the major stumbling block. Service companies may be able to work a deal with someone like Chevron, with payment in hard currency outside the Soviet Union. Otherwise, payment likely will be in barrels of crude. Dresser is now selling both equipment and the technology to manufacture that equipment, but as well has indicated they would be willing to invest directly in the USSR, in manufacturing capabilities, once a bilateral investment treaty is in place.

Nevertheless, I would not expect, even should all current negotiations be successfully concluded, that these joint venture operations would contribute substantially to domestic supply before the mid-1990s.

The technical challenges which Chevron and others will face in oil field development have been resolved some time ago in the West. But the challenges of doing business in the Soviet Union are another matter. A completely inadequate infrastructure is one obstacle, and the poor operational state of its pipeline network is a prime example.

Last year, a leak from an LPG pipeline led to an accumulation of gas in a lowland area. Two passenger trains passed through the lowlands simultaneously, a spark detonated the gas, which led to the death of 1,224 passengers.

There will be more pipeline accidents. A Soviet official has admitted that it is not possible to vouch for the reliability of those pipelines built during the latter years of the Brezhnev presidency, when as many as 4,000 km of 56-inch pipe were being commissioned annually.

In the first half of 1988, oil pipeline breaks alone caused the loss of 7.3 million barrels (310 million gallons). The Valdez oil spill, for comparison, was 10 million gallons.

Having said that, beyond these obstacles stand the real constraints to doing business in the Soviet Union.

We can recall the Bush-Gorbachev summit meeting in Houston this past June when, among other things, a trade agreement was signed by the two presidents with great flourish. Unfortunately, all we have so far is a piece of paper, and nothing of substance can happen unless and until the Soviet government codifies their emigration laws. That may come within the next several months.

Is there a bilateral tax treaty between the two countries? No, there is not. Is there a bilateral investment treaty? No, there is not, although negotiations continue on both.

Are we certain about decision-making authority? Do we know precisely who must be involved when joint venture contracts are being negotiated? No, we do not.

Joint venture laws are still immature. These laws came into existence in January, 1987, with some minor changes added since then.

In the USSR, rules seemingly are made to be bent, or broken. So it is with joint venture laws. If your partner has sufficient stroke, Western requirements can be accommodated. For example, joint venture requires that profits in hard currency must be earned only from exports. That means the Western partner will find itself competing in its own markets outside the Soviet Union. There are ways to secure approval of a joint venture without having to resort to exports. One compelling approach is to argue on the basis of import substitution.

The move to a market-oriented economy can only complicate matters, from the point of view of reaching agreement on joint ventures and other business arrangements. We do not know for certain what the results will be -- political upheaval and greater economic distress and decline clearly are strong possibilities. Any corporation would be well advised to move with added caution in the coming weeks and months, as the shift to a market economy unfolds.

When the Mosbacher delegation was in Moscow, it met with Artyom Tarasov, vice president of the Union of Cooperatives. He warned his audience not to sign deals with the Soviet government, that these documents, because of the political instability in the country, could prove worthless.

IV.

Gorbachev, since he came to power 5 years ago, has been faced with one disaster after another, some of his own making, some not: the Chernobyl nuclear power accident, the Armenian earthquake, a drastic decline in world oil prices, a failed antialcohol campaign, the Baltic search for freedom, coal miners' strikes, ethnic unrest deteriorating into civil war, a devastating pipeline explosion, a threatened oil workers' strike.

The cost to the economy has been tremendous, and the bills are still coming in.

The Cold War has been declared over. But that war, like all wars, has had its victims. The victims are the economies of Eastern Europe and the Soviet Union. Restoration is going to be a long and costly process and we and others must decide what role, if any, we are going to play in that process.

Continued declines in Soviet oil production hold implications for just about everybody. Especially for Eastern Europe, which obtains most of its oil from the Soviet Union, but also for the US. Will reduced domestic production signify that the Soviet Union will come looking for oil in the Middle East? Is an added competitor, especially one who seeks political gain as well, to our advantage, as our own imports reach the 50% level?

Alternatively, do we step in, and help the Soviet oil industry regain its health? Is that in our longer-term interests, particularly at a time when the future of Gorbachev would appear to be not all that secure?

Corporate decisions to do business with the Soviet Union presumably will be pragmatic. That is, will the anticipated return on investment meet company criteria? That is as it should be. While it is nice to have government backing, we have been down that road before, during the detente days of the 1970s, and there was a lesson to be learned when government support vanished, to be replaced by sanctions.

There is only one question that corporations need to answer. Have we done all our homework?

PROSPECTS FOR SOVIET OIL & GAS EXPORTS TO EUROPE

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To make forecasts about Soviet Energy Exports has always been very delicate, mainly because of the lack of sufficient information. Statistical figures were treated as secrets and therefore only published to a limited extent and even if published they have not necessarily been reliable. Obviously, when there is little data upon actual trends which considerations about future developments could be based on, forecasting is not an easy task, moreover, as in view of the many authorities involved there is no clearcut view emerging about an export policy.

With glasnost - openness - being introduced the situation has somewhat improved and at least the availability of statistical data from Goskomstat, the statistical office, has increased and apparently the figures published are more reliable. On the other hand glasnost makes transparent to us the conflicts in the Soviet-Union about how to introduce market mechanisms in the country and in many instances, and particularly so in the energy sector, the only thing we can clearly see is confusion.

Maybe even more than in the past, forecasting about the Soviet-Union is to a large degree guesswork. Nevertheless the exercise has to be made as best as possible and there is no doubt about the importance of assessing the export potential of the USSR in the next decade. Certainly a decrease in oil exports would be to the benefit of OPEC and in consequence influence both OPEC production levels and world market prices. As for the gas, the Soviet efforts to maintain or increase their market position in the European market seen against the background of growing competition from other supply sources will definitely have implications on the overall gas-price situation.

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(OVERHEAD)

Let us make a quick look at our scenario of the consumption of primary energy as this will be the base of the more detailed look at the oil and gas situation. Generally I shall show you the tables with our expectations and then comment on the individual items. As you can see, we have concentrated on 1995 and 2ooo as typical years. We believe there is not much sense to break up into single years as within the periods and allowing for the high degree of uncertainties the developments may vary considerably.

Total energy consumption between 1985 and 199o grew at an annual rate of 2 - 2.5 %. Between 199o and 2ooo this is going to be reduced to 1.5 % per year, parallel to the expected low growth rate of the economy. The share of oil and gas will increase from 68 % in 1985 to 73 % in 2ooo. The share of coal will decrease as there will be replacement by gas, the share of electricity will increase primarily due to household use.

Let me come to

THE OIL SITUATION

now.

(OVERHEAD)

PRODUCTION

Since the peak year 1987 production has been constantly declining and we expect a further decrease of 5 % between 199o and 1995 and a further 2 % to 2ooo.

1. Although oil is produced in a large number of areas 2/3 of the output is concentrated in West Siberia. Production at the Tyumen area (Samotlar field) is slowing down mainly due to rapid expansion beyond the maximum operating capacity and intensive exploitation. At the same time production in the Ukraine and European Russia has also reached the limit and is declining. This decline will not be offset as in view of the geological structures no big oil fields are expected to go into production within the next few years.

2. Production costs are rising as the big oilfields are gradually replaced by a number of smaller ones. New exploration in Siberia is conducted in a hostile environment where lack of infrastructure and rough climate require special equipment. The same applies for activities at the continental shelfs of Sachalin, the Baltic Sea, the Barent Sea and the Black Sea.

   The share of deep drilling at high cost is also increasing and so are development costs for pipeline connections which have to be constructed.

   Maintenance practises as workover and well servicing will lead to increased costs as a lot of the obsolete equipment used will have to be repaired or replaced.

3. Acts of civil disobedience and series of general strikes as recently observed will have a negative impact on production. It is also to note that the production of oil field equipment is concentrated in Azerbaijan, an area of notable unrest within the population. Disruptions in supplies of equipment due to strikes at the plants will make it more difficult to reach production targets. The recently growing concern for protection of the environment could certainly also slow down the growth of production.

4. Investment in energy as a percentage of total instustry investment has grown from 28 % in 1975 to 4o % in 1989 but is unlikely to grow further and more likely to be reduced. This question is heavily discussed within the Soviet authorities. As maintenance is badly needed any reduction in investment obviously leads to a reduction in production efficiency.

5. Although basically using the same field development technologies the approach of the Soviets is totally different from the west as to the way the water flooding method is being used. With the intention to gain a fast build up of production they favour the immediate use of large-scale waterflooding. This is in contrast to a more step-by-step use of waterflooding generally applied by western oil companies in order to maximize the recoverable reserves of an oil structure. The Soviet way not only does damage to the field and reduces the recovery factor but at the same time increases the operating costs because more wells are needed and an increased handling of water occurs.

   To reach better flow-rates the use of enhanced recovery methods, such as CO2 injection, polymere flooding, internal combustion and steam injection has remarkably increased since 198o. Since the same time the reliance on suckerrods as an instrument for production is diminishing and more and more artificial production methods like gas-lift and electric submersible pumps are used. The appliance of the methods mentioned and the increased use of sophisticated technologies supplied through joint ventures with Western oil companies shall have a positive effect on production levels during the second half of the decade.

6. A number of projects are in the stage of discussions - Chevron at the Tengiz oil field, Elf at the Volga/Caspian region - and apart from introduction of Western technologies these projects will develop larger structures. However, although restrictions on foreign companies have been eased there are still many uncertainies mainly on the legal side so that for the time being the projects are at the stage of dating a fiancee rather than fixing the wedding date, so realistically the impacts will be seen only in the second half of the decade. Under the economic reform the focus will be put more to individual enterprises and there will be the encouragement of hard currency rights for 5 to 2o % of the earnings on production above target, which possibly will also have a positive implication.

IMPORTS

These comprise mostly crude oil from Libya, Iraq, Iran and Syria mainly received in exchange for arms.

CONSUMPTION

1. Oil consumption in the period 1985 to 199o has been relatively stable, the total decrease over this 5 years period amounts to 2 %. Increased demand for transportation fuels compensated for the savings being made in using less oil for power generation. Moreover, energy conservation measures so far have not been very successful.

   We assume that in the period 199o to 1995 we shall see the decline to continue in the same magnitude and a further more pronounced decrease of about 3.5 % in the period to 2ooo. Replacement of oil by natural gas has been a factor in the past but it will play an increasing role in the future. Gas will become the predominant factor in covering future energy demand. Substitution of oil by gas is not only planned for power plants and industrial users but more and more also in the housing and municipal sector.

   As far as products are concerned, the demand for residual fuel, being replaced by gas, will be reduced, the use of light products for petrochemical and transport purposes (tractors, agricultural trucks, more passenger cars) will increase. Given the refinery structure of the Soviet Union the increased requirement for light products will be difficult to cope with and apart from the need to invest in converting facilities will propably be covered by a withdrawal from product exports.

2. The deterioration of the economy will result in a reduced demand for oil. The economic growth in particular during the first half of the decade will be slow.

3. The reform of the economy will lead to a decrease in demand. Once subsidies are cancelled and prices are genuine market prices the impacts on the demand side will be substantial. We have seen Hungary, Czechoslovakia and Poland drastically increasing their domestic prices and certainly the Soviet Union will have to increase prices dramatically from the present level if they take market mechanisms seriously.

   Simply because consumers can no longer afford it, they will be forced to economise. In that connection we should not forget the noticeable impact we experienced in our western economies when after the oil shock prices of products increased sharply and as a result led to substantial conservation measures.

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4. The necessity of energy saving and more efficient use of energy have been recognised as important, actual achievements, however have not been very sigificant. The oil requirement per unit of GNP in the Soviet Union is extremely high. In 1986 a figure of 1.o4 toe/US-$ 1ooo compares with o.41 for Europe, o.44 for the USA and o.64 for Canada. In various speeches Mr Gorbachev has critisized the excessive use of energy and stressed that the economic reform will force enterprises to economise energy input. The use of more efficient technologies in industry and the use of meters and thermostats in individual households will become more influential. Of course in this area, too, the question of funds required for the introduction of the instruments mentioned has to be solved and we are not too optimistic in that respect.

EXPORTS

The Soviet Union is a primary commodity exporting country, mainly exporting raw materials and little manufactured goods. Oil exports still play the vital role as they contribute to about 6o % of its hard currency revenue. Declines in hard currency income can be financed through gold sales, borrowing and drawdown of hard currency reserves but not as a long term policy. Gas contributes only 2o % of the total hard currency income but despite the increasing volumes to be expected will not be capable to replace oil earnings. Furthermore, oil exports are more attractive than gas as they offer greater flexibility.

Therefore in view of the funds needed to finance the modernisation of the economy the Soviet Union has no other choice but to continue to export as much as possible to hard currency customers. Not to be forgotten is the income needed to pay for grain imports as otherwise bread-shortage would have serious political implications.

Exports are to be seen as a target figure related to both income and volume which is also demonstrated by the flexible export policy in the past, linked to market situations. As a consequence of production decrease and consumption we see a decline of exports to 1995 and a slight increase to 2ooo, volumes to the west will however remain unchanged at present levels as the brunt of the reductions will be borne by Eastern Europe. We expect cutbacks in supplies from the Soviet Union one one hand and a growing interest to diversify supply sources on the other hand. By 1995 pipeline connections with Western systems should be existing to make it possible to use import alternatives. We believe however that the Soviet Union will continue to be the major supplier to Eastern Europe as it would be unwise to forgo the existing infrastructure of pipelines and storage facilities. Imports to Eastern Europe as from 1991 will be on a Dollar-base at worldmarket prices. A lot of countries is negotiating clearing agreements where crude oil imports would be offset against manufactured goods exports so that at least partially the Dollar-payments would not actually be executed. Nevertheless, it has to be mentioned that even allowing for this fact there will be extra hard currency income for the Soviet Union also for their exports to Eastern Europe.

(OVERHEAD)

THE GAS SITUATION

PRODUCTION

Gas production has been increasing by about 6 % annually until 1988 and by a little more than 3 % since then. We believe in a continuation of the recent 3 % to 3,5 % figure until 1995 and then an improvement to 4 % per year.

As with the oil 2/3 of the production is concentrated in Siberia, the main areas being Yamburg, Urengoy and the Yamal peninsula. In contrast to crude the reserve potential (4o bill. t oe : 8 bill. t oe) is big enough to consider the above mentioned growth rates as realistic ones. The Yamal production will go on stream in 1994/95 and the giant fields of Shtokmanov in the Barents Sea (3-4 times lager than the Troll field) and Russanov in the Kara Sea (2 times the Troll field) will go on stream at the end of the decade. This should provide a solid base for a production increase.

The problems encountered at gas production are similar to those of crude production. The exploration areas are in remote regions in evironments with severe climatic conditions which require special equipment and cause an increase in extraction costs. At the same time with production moving northwards transportation costs are rising.

The most serious challenge for the gas industry is given by the poor infrastructure as far as transportation is concerned. The safety condition of the pipeline network is substandard mainly due to the use of inappropriate pipeline steel which becomes brittle at zero degree temperature. There are also

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substantial corrosion problems due to inadequate coating materials. It is estimated that a quarter of the Soviet gas pipeline system needs repair or replacement. An improvement will be necessary to fullfil the exploration plans and cover increased domestic consumption. This will of course add substantially to production costs which in turn cause the need of higher funds to be invested.

In view of the high development potential on one hand and the fact that most of the total energy demand growth is intended to be covered by gas on the other these funds will have to be provided. The means to do so will be a significant increase of domestic prices to get a more economical use of gas, investment by western companies and expansion of exports.

A number of joint-ventures for field development and exploration have already been concluded with western companies and these should help to push up production in the second half of the decade.

CONSUMPTION

Gas consumption has been increasing steadily since 1985 and will continue to grow at an annual rate of 3.5 % until 2ooo. Since 1985 the share of gas in total energy consumption has increased from 35 % to 4o % in 199o and will further increase to 44 % in 1995 and 48 % in 2ooo.

As already mentioned, replacement of oil by gas in domestic consumption is a prime target of the Soviet Union. The present distribution of consumers shows a 13 % share of households and the communal sector, a 45 % share of industrial use and a 38 % share of use in power stations. Despite the low figure for households, 8o % of them are supplied with gas, mainly used for cooking purposes since heating in the cities is chiefly provided by district heating. Although district heating shall become more important this means that the absorption potential lies in the industry and to a major extent in power generation where many stations are designed for dual oil-gas use. Also there is a number of newly built and planned gas-fired power stations. To a greater extent than now gas will also be used for compressor stations in pipeline transport.

The problems to be seen, however, are lack of a sufficient distribution network and storage facilities. Gas storage capacity was neglected until recently but will be essential to replace oil without fluctuations or interruptions during the winter months when consumption is peaking.

We take a rather conservative view regarding the ability of the industry tc absorb natural gas together with the need for technical adjustment as it will be a question of the funds necessary to do so. In particular in the first half of the decade we do not see these developments happen with the speed desired.

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EXPORTS

It should be mentioned that the export share of Soviet gas production amounts to only 12 % so that in many instances exports can be seen as a by-product of the domestic industry. Given the fact that gas exports are the number two contributor to Soviet hard currency income, this of course does not mean that exports are of minor importance.

With the growth potential of production as illustrated, there is a growth potential for exports as in the coming decade production will grow faster than consumption. The potential will be higher the more successful the Soviet Union will be on economising domestic use of natural gas.

Gas exports have grown considerably in the 1980ies and will further continue to grow. Exports have been split almost 5o:5o between Eastern Europe and the West. Most of the agreements concluded started in the middle 70ies and early 80ies and will end in the late 90ies so that a big share of the export potential is already contractually committed. Since the mid 80ies no new agreements have been concluded due to the decline in European demand and the strong competition from Norway. With ever growing environmental pressures and concerns about the use of nuclear energy we can expect European demand for natural gas to increase over the next decade. Apart from Germany we see in particular Italy and Sweden as rapidly growing markets. The Soviet Union certainly will be interested to keep its reputation as a reliable and stable supplier and endeavour to increase its market shares and enter into new markets. It is in a good strategic position for supplies to West and South Europe and Scandinavia. This also makes it very competitive vis-a-vis Norway and Algeria. In East Europe the Soviet Union will increase its market share. Present contract obligations will continue albeit on new terms. GDR and Czechoslovakia will emerge as most attractive markets as on environmental considerations lignite will be replaced by gas and there is a high demand potential for use in power plants and municipal systems.

To summarise our views: There is a high probability of export volumes for crude on present levels and for gas on increased levels. To sustain this position it will be necessary to provide technical and most of all financial aid to the Soviet Union assisting them to overcome production and maintenance problems. Impacts and prospects are to be seen mainly in the second half of the decade and together with the introduction of market mechanisms and measures for energy saving could even lead to increased export volumes.

SOVIET OIL BALANCE

mio b/d oil equ.

	1985	1986	1987	1988	1989	1990	1995	2000
PRODUCTION	11.9	12.3	12.5	12.5	12.2	11.7	11.2	11.0
IMPORTS	0.3	0.3	0.3	0.4	0.4	0.2	0.3	0.3
EXPORTS	3.3	3.7	3.9	4.1	3.9	3.2	3.0	3.1
of which to:								
Eastern Europe	1.9	2.0	2.0	1.9	1.9	1.4	1.2	1.2
West	1.4	1.7	1.9	2.2	2.0	1.8	1.8	1.9
APPARENT CONSUMPTION	8.9	8.9	8.9	8.8	8.7	8.7	8.5	8.2

SOVIET GAS BALANCE

mio b/d oil equ.

	1985	1986	1987	1988	1989	199o	1995	2ooo
PRODUCTION	1o.4	11.1	11.7	12.4	12.8	13.2	15.7	18.4
ooo mill m^3	643	686	727	77o	796	815	97o	114o
EXPORTS	1.1	1.3	1.3	1.4	1.5	1.5	2.1	2.4
of which to:								
Eastern Europe	o.6	o.7	o.7	o.7	o.8	o.8	1.1	1.4
West	o.5	o.6	o.6	o.7	o.7	o.7	1.o	1.o
APPARENT CONSUMPTION	9.3	9.8	1o.4	11.o	11.3	11.7	13.6	16.o

SOVIET PRIMARY ENERGY CONSUMPTION

mio b/d oil eq

	1985	1986	1987	1988	1989	1990	1995	2000
OIL	8.9	8.9	8.9	8.8	8.7	8.7	8.5	8.2
GAS	9.3	9.8	10.4	11.0	11.3	11.7	13.6	16.0
COAL	5.9	6.0	6.0	6.0	5.8	5.8	5.6	5.5
ELECTRICITY	1.6	1.6	1.7	1.9	1.9	2.1	2.7	3.1
OTHER	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6
	26.4	27.0	27.6	28.3	28.3	28.9	31.0	33.4

OPPORTUNITIES FOR OIL AND GAS DEVELOPMENT IN THE USSR

Presented by

Mikhail B. Korchemkin
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NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

Economic crisis, the USSR is living through now, has spread over the most powerful and successful part of the Soviet economy - the energy sector. In 1989, for the first time in the post-war history of the country, the primary energy output declined. The production of oil and condensates decreased from over 12.51 mbdoe in 1988 to 12.17 mbdoe, coal from 6.56 to 6.28 mbdoe (772 and 740 million metric tons, respectively), nuclear electricity from 0.98 to 0.96 mbdoe (216 and 212 TWh). Hydroelectricity generation showed a minor increase, and the growth of natural gas production from 12.49 to 12.91 mbdoe (770 and 796 bcm) could not compensate the decline in oil and coal output (Slide 1). This tendency became even worse in 1990. In the first half of 1990, the output of oil dropped by another 0.5 mbdoe from the corresponding level of 1989 (Slide 2), coal by 0.4 mbdoe (24 mill.metric t); the total production of fossil fuels was less by 0.6 mbdoe.

There are numerous factors pushing down the energy production in the Soviet Union. The most important one is probably the shortage of capital to keep the output at a stable level. In 1988, the energy sector consumed more than 24% of the total capital investments into the Soviet economy. The country can hardly afford to carry that burden any longer. The 1990 budget was cut significantly. For instance, the gas pipeline construction budget is just 0.9 billion roubles (about US$ 1.5 bill.), compared with 3.3 billion in 1989 and 5.1 billion in 1988. The corresponding decrease in new trunkline construction is limiting the expansion of natural gas use in the country. For environmental reasons, the administration of Tyumen province, West Siberia, has blocked the development of gas fields in the Yamal peninsula, which created additional problems with increase of gas supply.

Oil extraction is becoming more and more expensive with the exhaustion of giant fields and the continuing move of production to the North of Western Siberia (Slide 3). From 1980 to 1987 the drilling for prospecting and exploration of oil increased from 12.5 to some 26.0 thousand miles a year (natural gas - 1.6 and 2.3 thousand miles, respectively).

Coal output dropped because of massive strikes by miners, troubles in the Soviet railroad system, and permanently worsening quality of coal. The planned nuclear power expansion has met a strong public opposition. It resulted in the phasing out of a number of projects all around European USSR. Actual output of nuclear electricity is well below the planned target announced in 1985, before the Chernobyl disaster (Slide 4).

The decline in oil production was followed by a serious decrease of exports. After hitting the record of 4.11 mbdoe in 1988, exports dropped to 3.70 mbdoe in 1989. Somehow, the decrease occurred mainly in exports to Western Europe: they were cut by almost 400 thousand barrels a day, The deliveries to CPEs (centrally planned economies) dropped just slightly (Slide 5). However, in 1990 the USSR supplies of oil to CPEs fell as well. Despite the decrease in volume, in 1988-89 Soviet revenues from oil sales to OECD grew from 6.5 to 6.8 billion "hard" roubles (the 1989 "hard" rouble value was about US$ 1.6-1.7).

The Soviet Union also cut its oil imports from 0.44 mbdoe in 1988 to 0.30 in 1989. The major flow of imported oil came from Iraq - 240 thousand barrels a day (Slide 6). Naturally, this flow has never reached the Soviet soil. It was sold or bartered elsewhere.

In 1988-89 natural gas exports continued to grow. European CPEs increased their off-takes from 43.7 to 51.7 bcm. OECD countries received 44.2 and 49.4 bcm, respectively. The corresponding hard currency revenues went up by 0.2 billion roubles and reached 1.9 billion. In April 1990, the Soviet Union started to import natural gas from Iran. The barter deal envisages annual deliveries of 3 bcm of gas for 15 years. Iranian gas will compensate the depletion of production in Western Caspian region. The USSR will construct several plants in Iran as a payment for gas.

The author's forecasts of both the future energy production and exports are given in his recent publication in "Energy Policy", Vol.18, No.5, June 1990 (Slides 7 and 8). The output of oil is likely to drop from 11.7 mbdoe in 1990 to 9.5 in 2000 and 8.7 in 2010. Note that the forecast considers the Soviet state sector only. Oil exports are to fall from estimated 3.2 mbdoe in 1990 to 1.6 in 2000 and 0.5 in 2010.

The energy future of the USSR depends on success of the announced change in the economy from central planning to a market basis and a good outcome of the stormy process of perestroika. To get out of the economic crisis, the USSR has to become a normal part of the world economy. The author ties this future with an opening of the Soviet energy sector for foreign economic investments. The energy sector has advantages over the majority of other industries of the country. Its outputs can be easily sold at international markets, while the quality of most Soviet products is well below the international standards. The sale of products inside the USSR creates a problem of transformation of rouble profits into something of value. It can be done only through a very limited number of goods, primarily through crude or oil products.

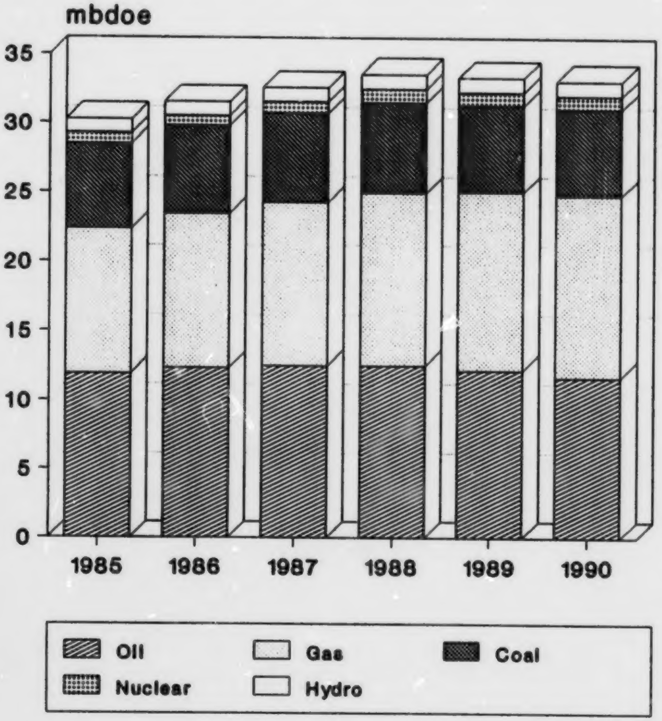
Some good signs can be observed in joint East-West activities in the energy field. In early May 1990, Soviet media reported about the joint development of Schtokmanovskoye gas field in the Soviet sector of the Barents Sea. The field is located some 370 miles from the Kola peninsula and has estimated recoverable reserves of 4800 bcm. "Norsk Hydro" (Norway), "Dutch Dupont Services", and Finnish "Wartsila", "Imatran Voima" and "Neste" will participate in the deal from Western side. The Soviet side is represented by the USSR Ministry for Oil and Gas. The actual production from Schtokmanovskoye field could start by the end of 1990s. This would be the first joint venture at the fuel extraction side in the USSR.

There are other East-West projects being started, such as a joint construction of petrochemical plants in West Siberia by "Combustion Engineering" and "MacDermott" of the USA, "Mitsui" and "Mitsubishi" of Japan, and the USSR Petrochemical Ministry. The plants are to produce polyethylene and polypropylene for both domestic and international markets. The project was heavily criticized by, nowadays free, Soviet media. However, it has found a very strong support in the federal government and Politburo.

Although a flow of foreign capital investments seems to be the only hope in overcoming the economic crisis in USSR, the very uncertain legislative environment is limiting such activities now. Each of the fifteen republics of Soviet Union has announced the priority of local laws over the federal those. It is not clear now who owns land and mineral resources in the country. It looks like local authorities of provincial and regional level are becoming more important than ministries and commissions in Moscow. For instance, the administration of autonomous region of Khanty-Mansi, West Siberia, has announced its full control over oil and gas reserves in the territory. When the neighboring Yamal-Nenets region follows, the two West Siberian provinces may acquire control over two-thirds of the Soviet production of oil and gas.

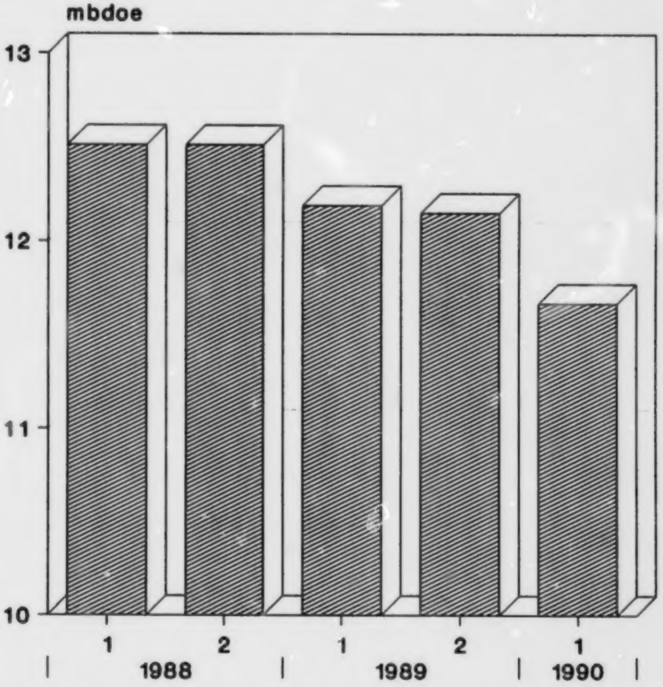
Hopefully, there will appear some serious guarantees for investments and private property in the USSR, not depending on their geographical origin. In the oil and gas provinces with a minimal exploration risk, it may cause a breakthrough in the Soviet energy development.

Slide 1
USSR Energy Production, 1985-90



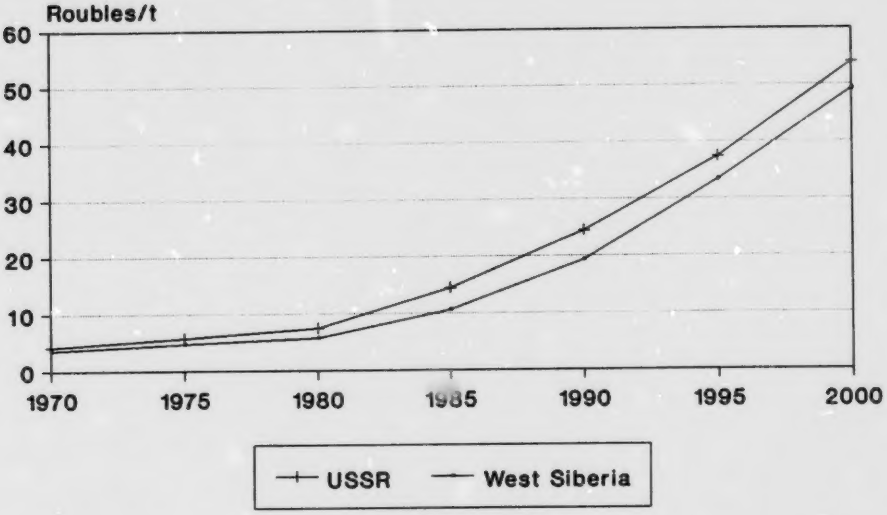
M.Korchemkin, 1990

Slide 2
Soviet Oil Production
Half-Year Breakdown



M.Korchemkin, 1990

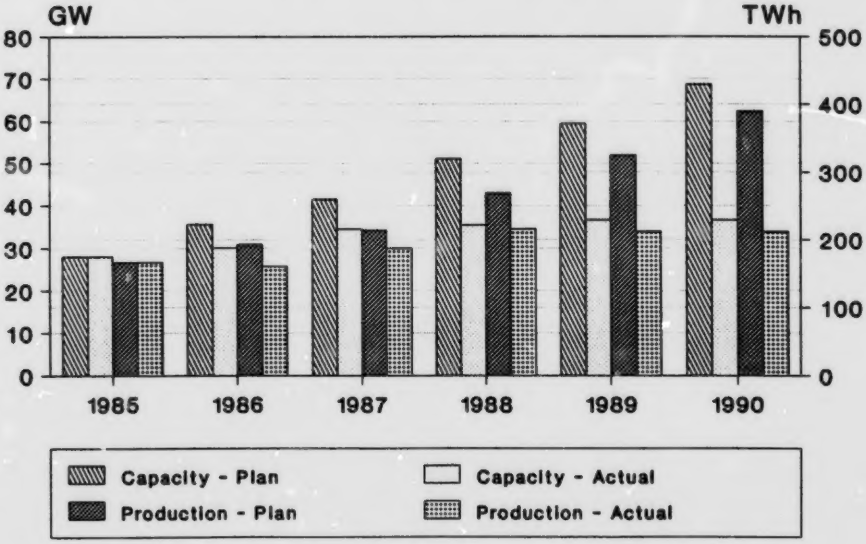
Slide 3
Change in Oil Production Cost



In Roubles of 1980

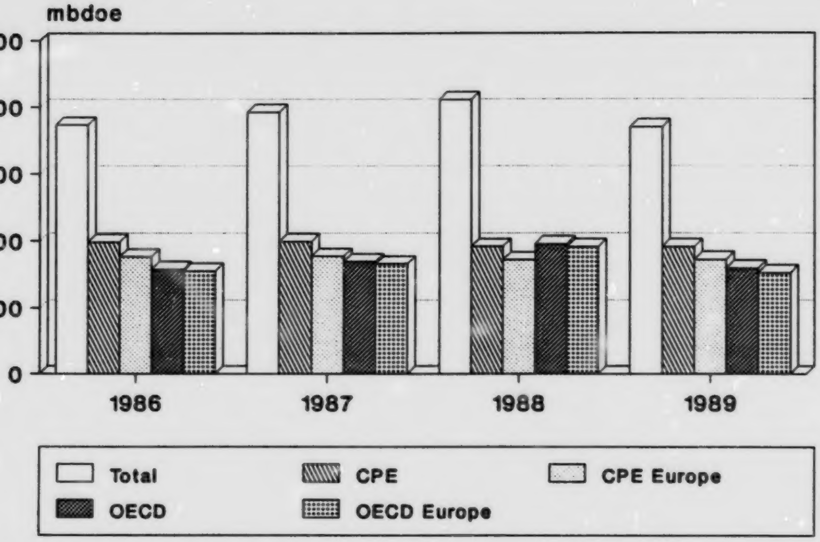
M.Korchemkin, 1990

Slide 4
Change of Soviet Nuclear Program 1985-90



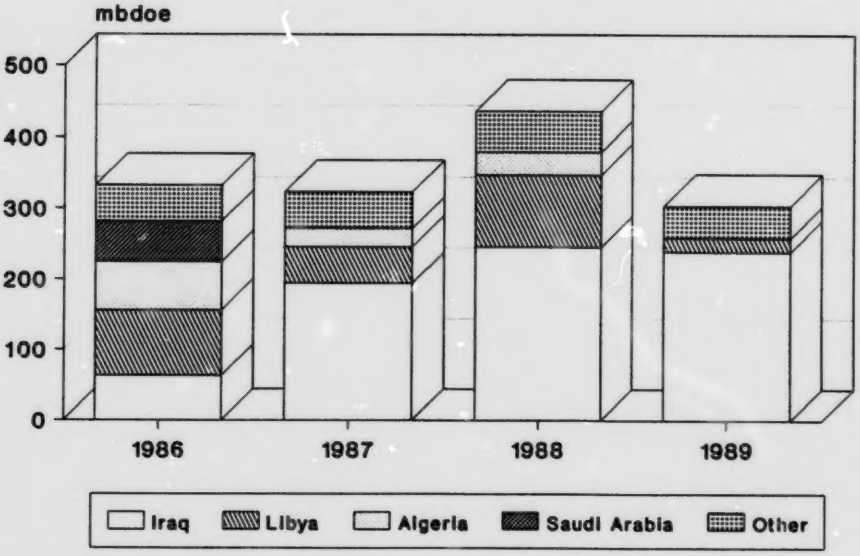
M.Korchemkin, 1990

Slide 5
Soviet Oil Exports, 1986-89



M.Korchemkin, 1990

Slide 6
Soviet Imports of Oil



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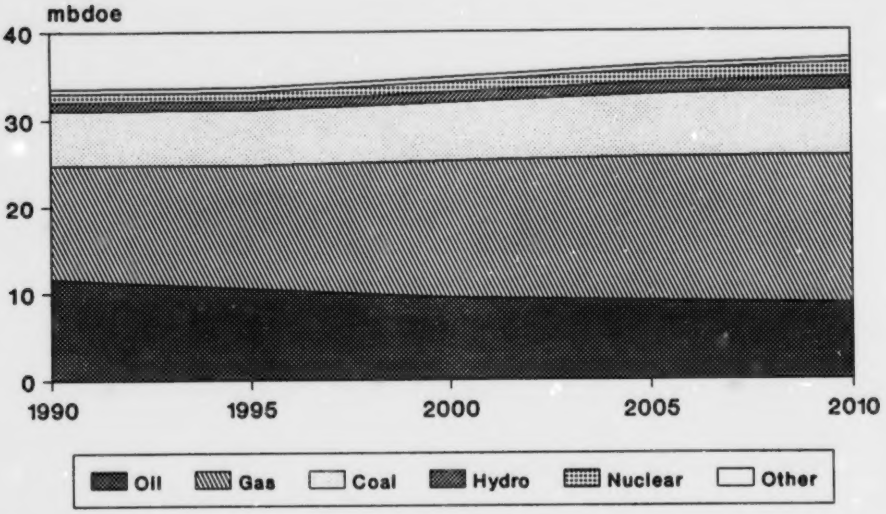
Slide 7

Soviet Energy Production, 1990-2010

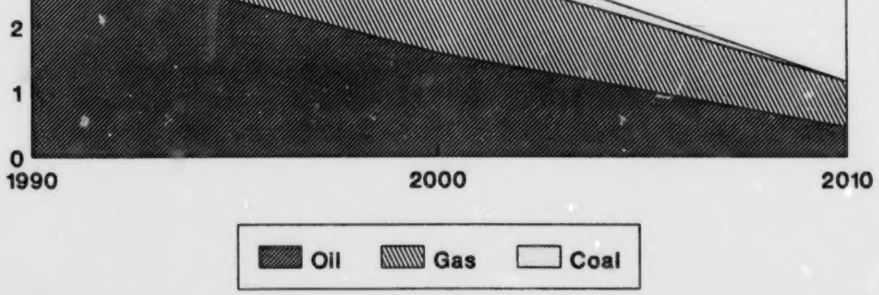
State Sector



M.Korchemkin, 1990

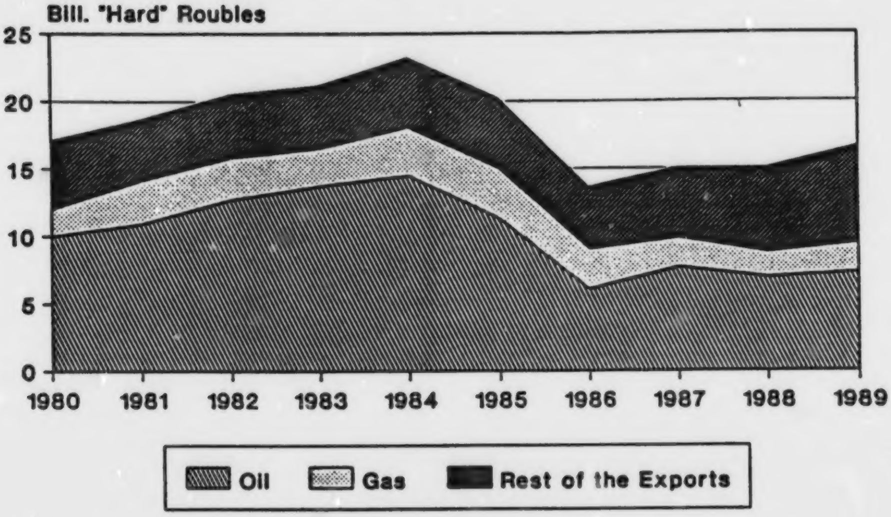
Slide 8

USSR: Future Fuel Exports

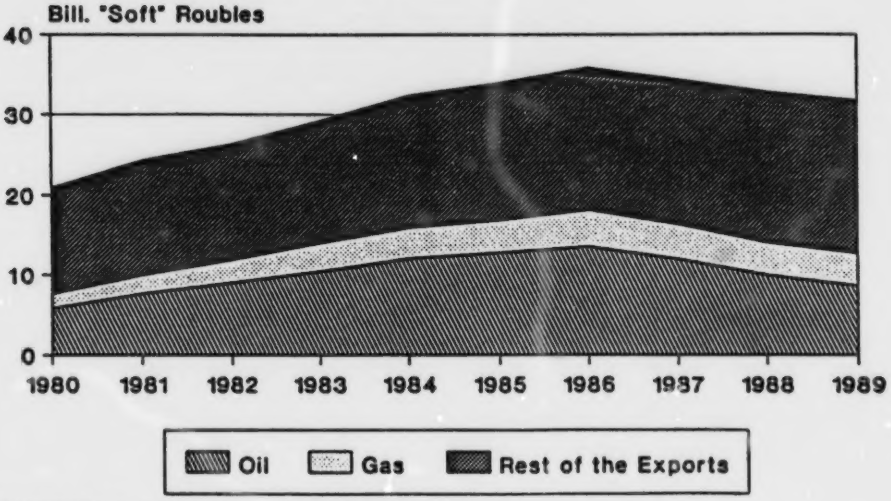


M.Korchemkin, 1990

Slide 9
Value of Soviet Oil & Gas Exports
to Western Europe & Yugoslavia

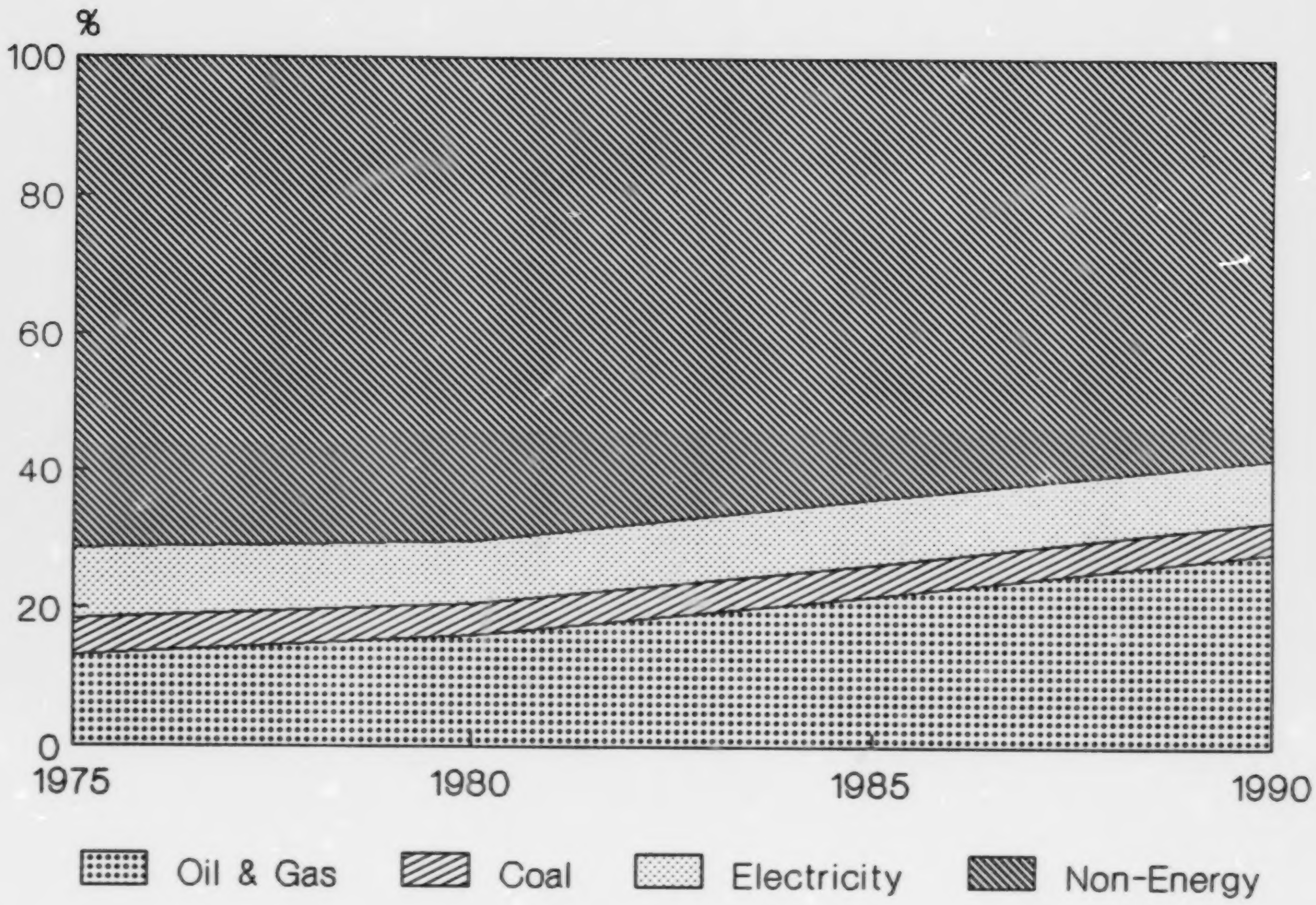


Slide 10
Value of Soviet Oil & Gas Exports
to COMECON-6



COMECON-6: Bulgaria, Czechoslovakia,
East Germany, Hungary, Poland, Romania

Share of Energy Production in the Total Value of Industrial Capital Assets

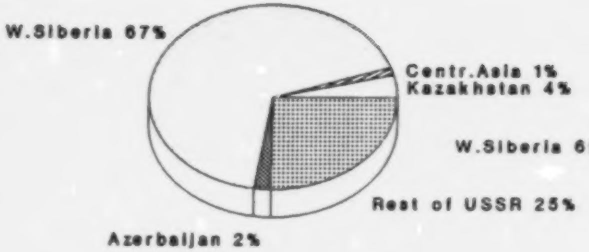


Soviet Regulations on Foreign Economic Relations: Controversial Development

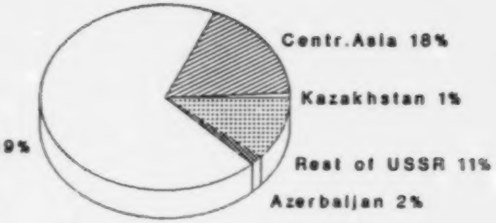
- Joint Ventures Law of 1987: The first (but weak) attempt to invite foreign investors.
- Dec. 1988: Certain improvements in the JV Law. All Soviet enterprises, cooperatives, collective farms permitted to carry on export and import business.
- March 1989: Introduction of limits on some foreign economic activities, including export of fuels.
- Dec. 1989: Embargo on non-State exports of crude oil, oil products, coal, timber, food, and some other materials.
- Fall 1988 - Summer 1990: Practically all republics of the Soviet Union introduced their own regulations on foreign economic operations. From the standpoint of the republics, their law is·prior to the federal one.
- Summer 1990: Parliament of the Republic of Russia announced its control over the oil and gas exports from Russia.
- Summer 1990: Parliament (Supreme Soviet) of the Autonomous District of Khatnty-Mansi, W.Siberia, declared its control over oil and gas reserves.
- Whom a potential Western investor is to address to?

M.Korchemkin, 1990

Geographic Breakdown of Soviet Oil and Natural Gas Production



Oil & Condensates



Natural Gas

M.Korchemkin, 1990

ID/5999P

1992 CHANGES FOR THE EUROPEAN NATURAL GAS MARKET

Presented by

Drs. J. Carrière, Director Gas Export
N.V. Nederlandse Gasunie
Groningen
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NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

Ladies and Gentlemen,

I am very honoured to be here today at the ninth Ceri International Oil and Gas Markets Conference to tell you something about the 1992 changes for the European Natural Gas Market.
First of all I would like to introduce myself. My name is Just Carrière and I am responsible within N.V. Nederlandse Gasunie for Dutch gas exports to Germany, Belgium, France, Italy and Switzerland.

(Slide 1) N.V. Nederlandse Gasunie is responsible for the purchase, transport and sale of natural gas in the Netherlands and for exports at the Dutch border as well. The company is not involved in production. The main producer in the Netherlands both off- and onshore is the Nederlandse Aardoliemaatschappij, NAM, a 50/50 joint venture of Shell and Esso. Shell is operator.
Shareholders of Gasunie are Shell, Esso, the Dutch State and EBN (formerly Dutch State Mines).
Our total annual sales volume amounts to approximately 70 billion m^3 of which 40 billion m^3 is sold in the Netherlands and 30 billion m^3 is sold at the Dutch border for exports. For comparison:
1 billion m^3 gas per year is about 100 million cubic feet/day, so 70 billion m^3 annually = 7 billion cubic feet/day.

(Slide 2) For those who are not familiar with the European Natural Gas pipeline grid, I would like to show you this map. It all started in Groningen, the Netherlands, with the discovery around 1960 of the large Slochteren gas field with reserves of 2000 billion m^3. From there the real natural gas business started in W. Europe, initiated by Gasunie and NAM Gas Export. Up to that moment natural gas distribution in W. Europe was only a small local affair, based on some indigenous gasfields (Germany, France, Italy).

Later on in the seventies and in the eighties Norway from the North, the USSR from the East and Algeria from the South became important suppliers to W. Europe. In the future, after 1992, these "big four" will remain important natural gas suppliers to Europe. There will not be too many significant changes in 1992 as the natural gas business in Europe has always been very much an international business, cros-border transport at many places and with large volumes. The large natural gas distributing companies such as SNAM, Ruhrgas, Gaz de France, Britisch Gas, Distrigas, Enagas, Dangas and Gasunie are working together in Eurogas to promote the international gasbusiness as good as possible within an united Europe.

(Slide 3) Energy in the Netherlands, Demand and Supply

In the Netherlands we have a very high natural gas penetration rate. About 50% of primary energy demand is supplied by natural gas. Penetration in the heating market amounts to 97%. From this it will be clear that our 40 billion m^3 annual sales will remain about constant in the long term, because the projected small growth will be compensated by energy saving measures.

(Slide 4) Factors for further European increase of natural gas demand

Because in the other West European countries, apart from the UK, the natural gas penetration is far less than in the Netherlands (on average about 18%), we will see a steady further growth in demand, to some extent reinforced after 1992 by an united Europe. The main reasons why can be seen on this viewgraph.
Natural gas for power generation can generate an enormous additional potential of more than 100 billion m^3 per year because many people believe natural gas is less polluting than coal and less dangerous than nuclear. The question is whether natural gas in such extra quantities will be competitively available as more and more remote natural gas supply sources have to be developed at ever increasing costs.
This extra natural gas potential for power generation is not included in the next slide. We do believe that in the end, whether we like it or not, a large part of this potential shall be supplied by coal, oil and nuclear power.

(Slide 5) Natural gas demand outlook in Europe

In this slide we have quantified the expected natural gas demand in Europe, excluding the USSR. From 1990 till 2010 it means an increase of about 160 billion m^3, that is an average growth of approximately 2½% per annum.
Recent developments in Eastern Europe (the upper part in the viewgraph) will lead to more natural gas demand in order to get rid of the large amount of polluting lignite in these countries. Up to now the natural gas in Eastern Europe was obtained from the USSR. In future these European countries will also buy gas from other supply sources directly and indirectly from German suppliers such as Ruhrgas and BEB.

(Slide 6) Contracted gas versus W. European demand

Returning to Western Europe, we will see what has to be done in order to cover expected natural gas demand in the future. As you will notice from this graph, supply and demand are in balance untill the mid nineties. Thereafter an united Europe will face an ever increasing supply gap, from 1995 onwards, which has to be filled in one way or another.

(Slide 7) Natural gas supply export countries

Back to Gasunie's export countries, W. Germany, Belgium, France, Italy and Switzerland, we see of course the same development because together they form a large part of W. Europe. However, the supply gap development is even more severe because they are mostly natural gas "have nots". In the former graph the UK and the Netherlands were included and these countries are in the fortunate position to be natural gas "haves" until far in the next century. From the slide the established position of the big four: the Netherlands, Norway, USSR and Algeria becomes very clear; quite different from the USA where we have probably more than a thousand different producers.
Indigenous production will gradually decline.

(Slide 8) European gas supply gap

From this slide it becomes clear that the European supply gap will grow exponentially because of

- 2½% average annual growth in demand
- gradual decline of today's contracted reserves

You will probably agree that the gas purchasing departments of the European natural gas distributing companies have a big job ahead in the forthcoming years. Not less than 300 billion m^3 per annum have to be purchased around 2010!

(Slide 9) World gas reserves in 1989

I do not want to discuss the world natural gas reserves, but I only want to show you a comparison between the two biggest natural gas "have's" in the world,the USSR and the USA.
Based on proven reserves, we see that the USSR has 9 times more reserves than the USA, mainly in very remote and inhospitable areas, on- and offshore in the north west of Siberia. It goes without saying that production - and transportation costs in such areas with primitive conditions and a very limited infrastructure will be high. Nevertheless it will be clear that the USSR reserves can play a very important role in the future natural gas supply of an united Europe, especially now that the dividing line between eastern- and western Europe disappears quickly.

(Slide 10) Possible supply sources Europe (1)

We already mentioned the large proven natural gas reserves of the USSR and the huge amounts of capital required to develop a large part of these reserves. Norway has in comparison with the USSR modest proven reserve's, but can nevertheless be of large value for an united Europe. Their supply position is already established; they only have to continue and to increase their volumes if and when appropriate. We do not believe it will be much in excess of 60 billion m^3/a to the Continent, using three large offshore pipelines.

(Slide 11) Possible supply sources Europe (2)

Algeria will certainly be prepared to increase her natural gas exports to Europe, mainly by means of extending existing natural gas pipelines to Italy and perhaps in future also by a new pipeline via Marocco and Spain to France and further on to N.W. Europe. LNG activities might be shared by Europe and the USA, provided that market price levels for natural gas allow further LNG developments at full costs.
We feel that Nigeria can become an important newcomer to the European natural gas supply front, also provided that the market value for gas in Europe can match the cost plus value of these LNG projects. Today's market value for gas at the European beach of about 2.20$/mmbtu (1$ = ƒ 2,00) will probably be too low. By the way the same applies for LNG projects from Algeria and Nigeria destined for the U.S.A. as long as the negative difference between market value and the full LNG cost are at least 1$/mmbtu as of today.

(Slide 12) Additional supply Europe

As we have seen from the foregoing, Europe needs a lot of new supplies from 1995 onwards to cover increasing demand and to replace existing contracts in decline. So, after 1992, an united Europe will be confronted with more and more natural gas supplies from non-EEC countries and from outside Europe. One of the reasons is the decline of local reserves in Germany, Italy and France.
Furthermore, Europe has to accept that the cost of gas will increase considerably because of larger distances and the greater capital intensity of projects.
The big question will be at which price levels, also taking into account the price levels of competing fuels, mainly oil products and to some extent coal, the future supply and demand for natural gas will be in balance.
So, the luxury in Europe at the moment, of having available a lot of relatively cheap gas in her backyard, will probably disappear rather quickly after 1995. The competitive position of natural gas will therefor become more difficult in the future. In my opinion, the same trend applies for the USA as from the mid nineties.

(Slide 13) Inland sales policy

As regard sales policies, we still maintain our netback philosophy in the Netherlands and Europe. This philosoply means that the price for gas at the border or the beach should amount to the revenues for alternative fuels (mainly oil products), plus premium value for gas minus distribution - and transportation costs including a fair return for the reseller. Because oil products are market leaders and will be market leaders in the future, it makes no sense to develop an independent natural gas pricing policy. If tax harmonisation will develop in Europe after 1992, natural gas price levels in the different countries will become more comparable.

(Slide 14) International sales policy (Dutch export)

Also after 1992, the Buyers shall have to face their volume risks. This means long term contracts (20-25 years) and high take-or-pay obligations. Otherwise it will be impossible to generate enough capital to develop new natural gas supply projects.
The Sellers shall have to carry the market price risks but they shall also be able to enjoy the market price advantages.
As oil product prices will remain leading in Europe and as long as oil products and natural gas are very good substitutes, natural gas prices and risks are at the mercy of the expected volatile price developments of oil products.
This could make it difficult to develop remote projects in the USSR and outside Europe, projects which require high capital investments.
In our export contracts, we expect sound marketing and efficient operations from our resellers. We grant them a reasonable return on investments and we periodically renegotiate the contract terms, mainly the price.
The currently established price is fully indexed with oil product price developments. This will also be the basis after 1992.
So, we as sellers are taking the market price risks, but also enjoy the market price advantages, logical result from the netback principle. The same principle applies for USSR, Norwegian and Algerian contracts.

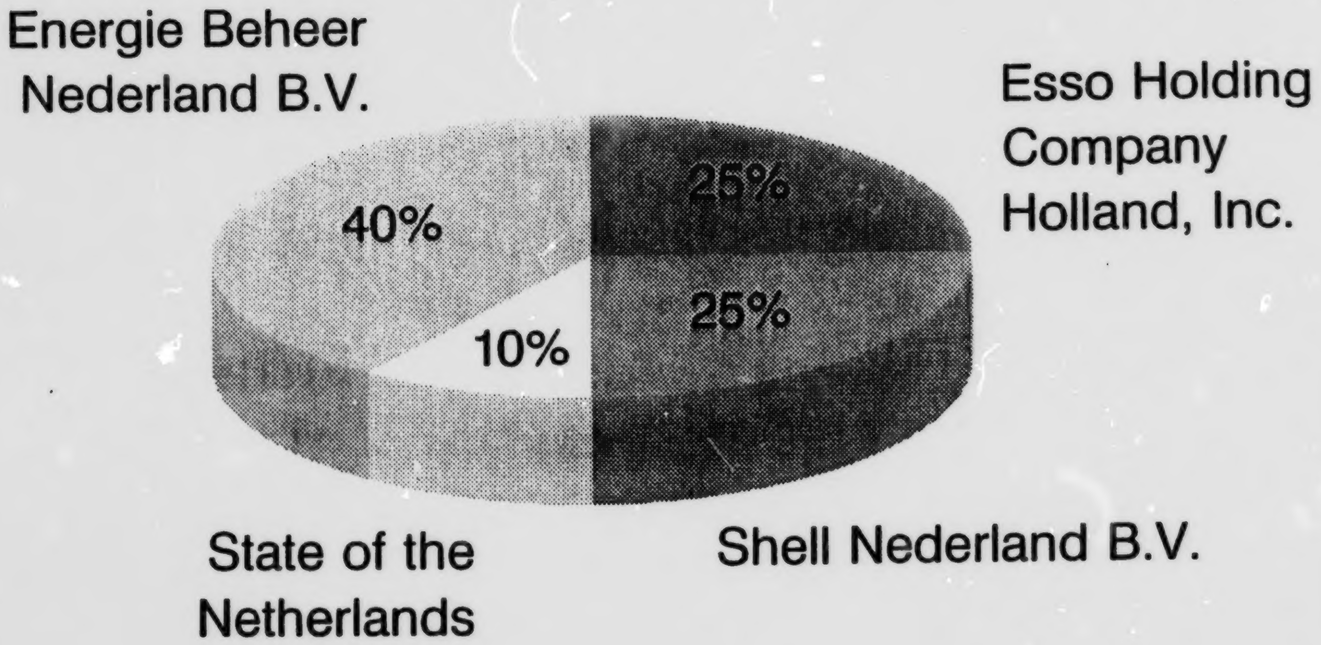
In conclusion

The conclusion must be that the European natural gas industry shall have a challenging job after 1992, to contract enough reserves to cover market growth and the decline of existing natural gas contracts.
The gas has to come from more and more remote areas, increasingly from outside the EEC countries.
The cost plus of such gas projects will increase, in some cases even dramatically. So, in the end there should develop a certain balance between future natural gas demand and future supply, depending on cost developments for gas production and transport at one side and market value for gas based on pricing developments for competing fuels, mainly oil products, on the other side.
The European natural gas industry will work close together, as she is doing already for a long time, in order to reach the best results for Europe, realising that the gas shall have to come in ever increasing quantities from remote areas outside the EEC and even outside Europe.

P.S.: All this has been written before the Koeweit oil crisis of August 1990. It is too early to predict the long term effect on both the future oil - and natural gas supply position for Europe. One thing is for sure: if this severe crisis will lead to extremely high oil price levels for a longer period, natural gas, coal and nuclear will strengthen their positions in the energy world.

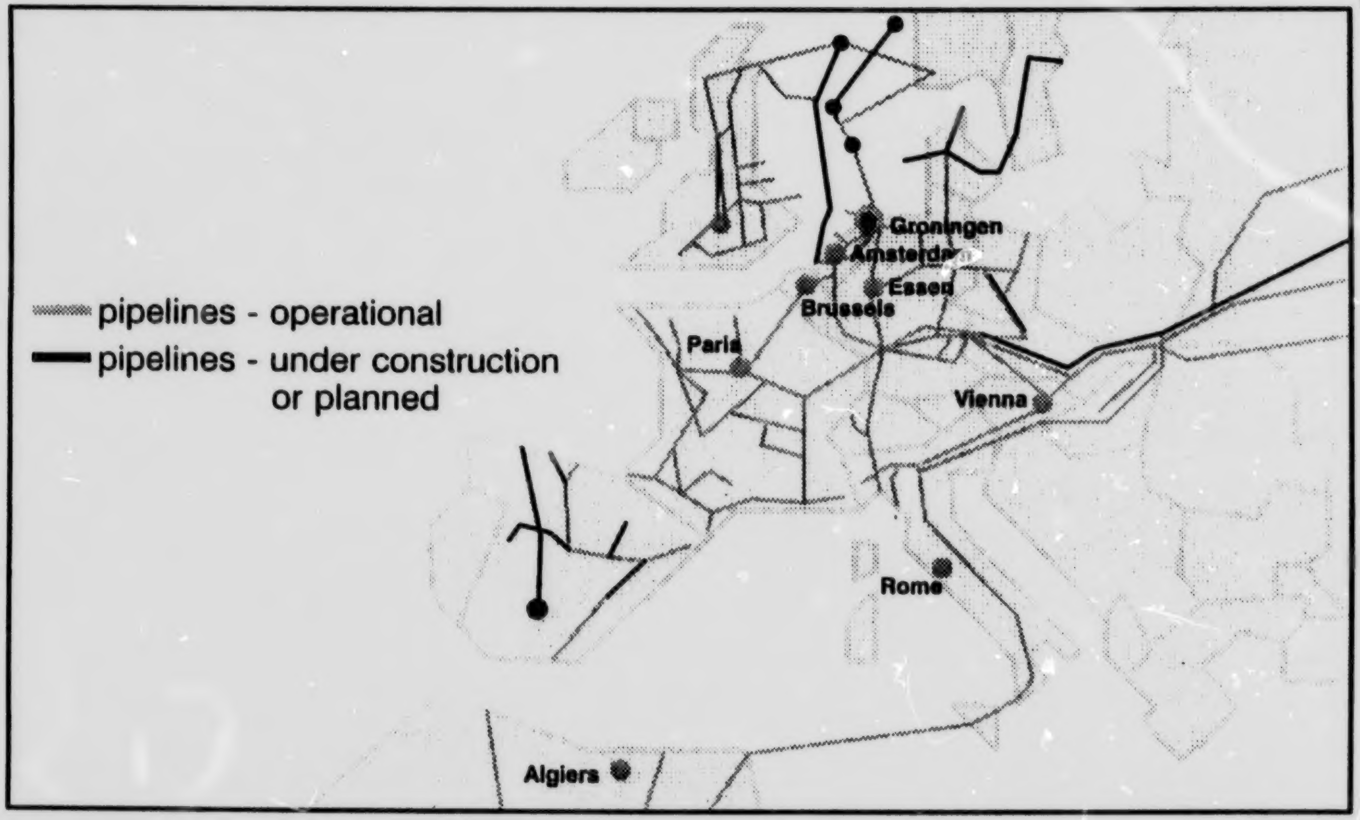
Sept. 1990

SHAREHOLDERS GASUNIE



EUROPEAN NATURAL GAS TRANSPORTATION SYSTEM

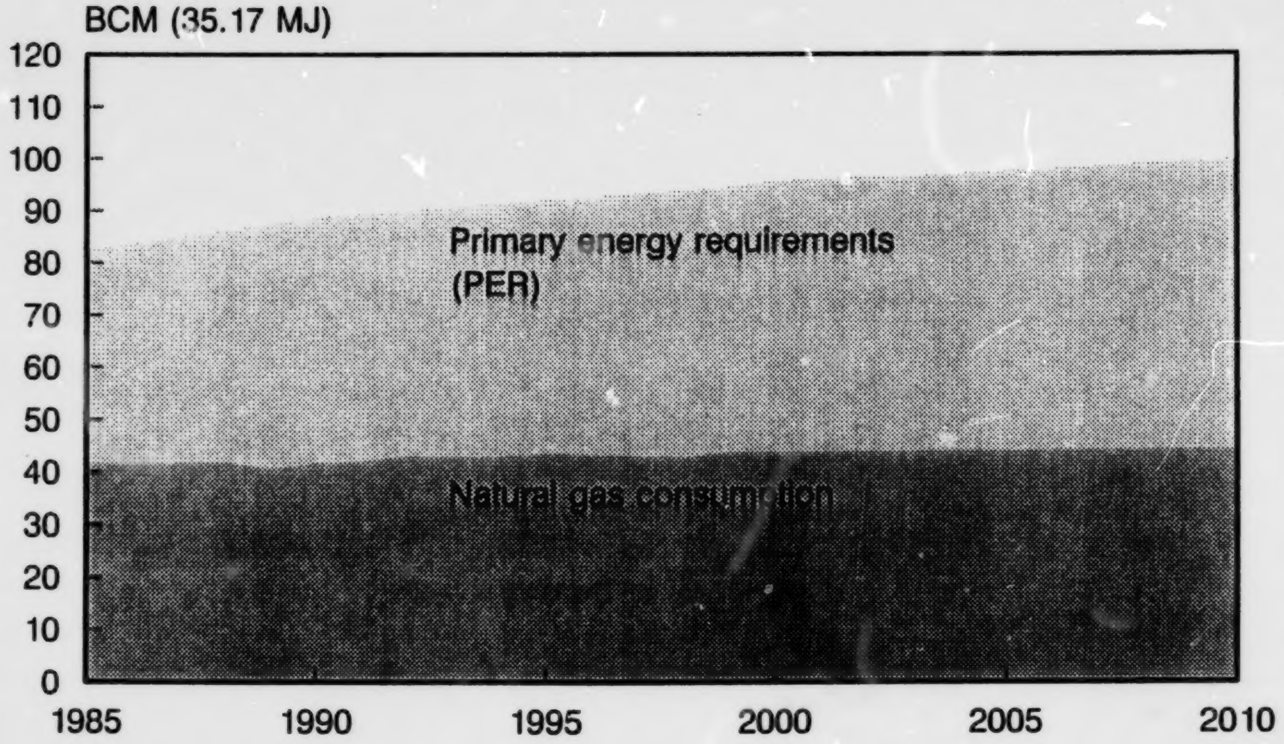
Sept. 1990


▨ pipelines - operational
▬ pipelines - under construction or planned
Groningen
Amsterdam
Essen
Brussels
Paris
Vienna
Rome
Algiers

ENERGY IN THE NETHERLANDS DEMAND AND SUPPLY

Slide 3

Sept. 1990



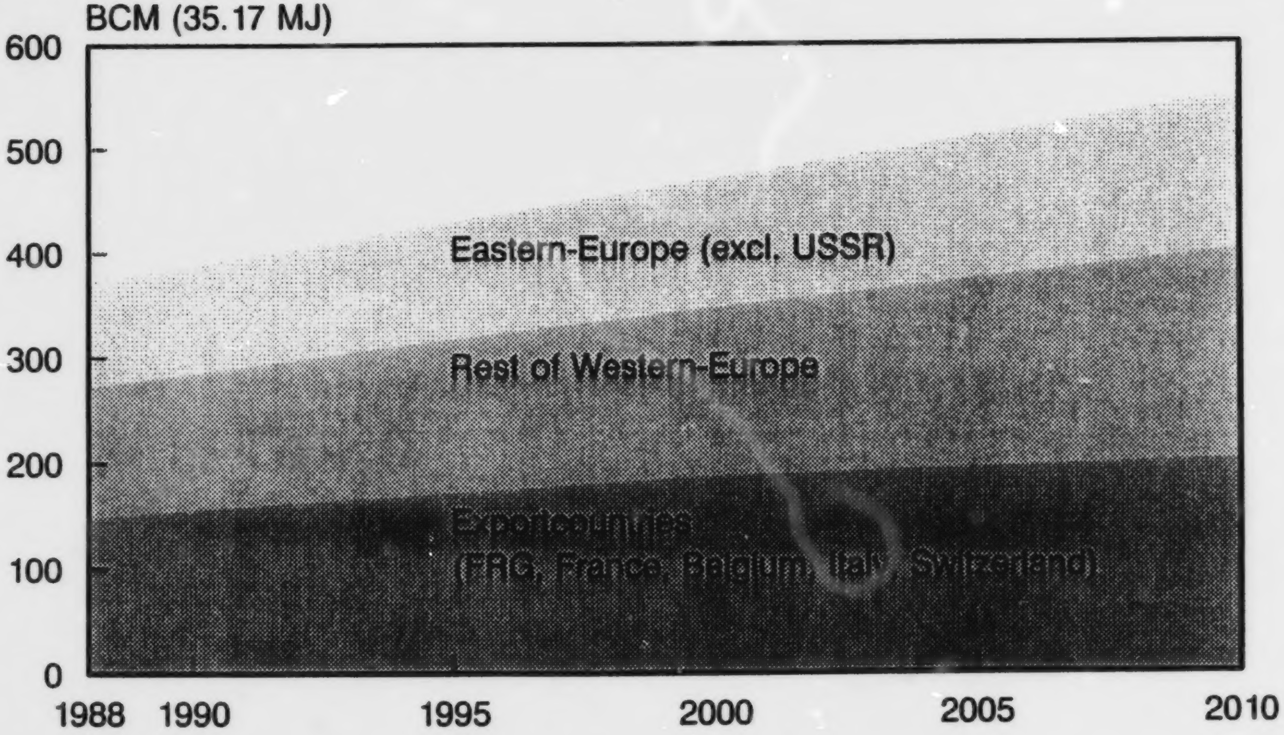
FACTORS FOR FURTHER EUROPEAN INCREASE OF NATURAL GAS DEMAND

Sept. 1990

- Economic growth and marketing efforts
- Environmental advantages for natural gas (SO_2 , NO_x)
- Setback nucleair programs
  - Hence natural gas for power generation

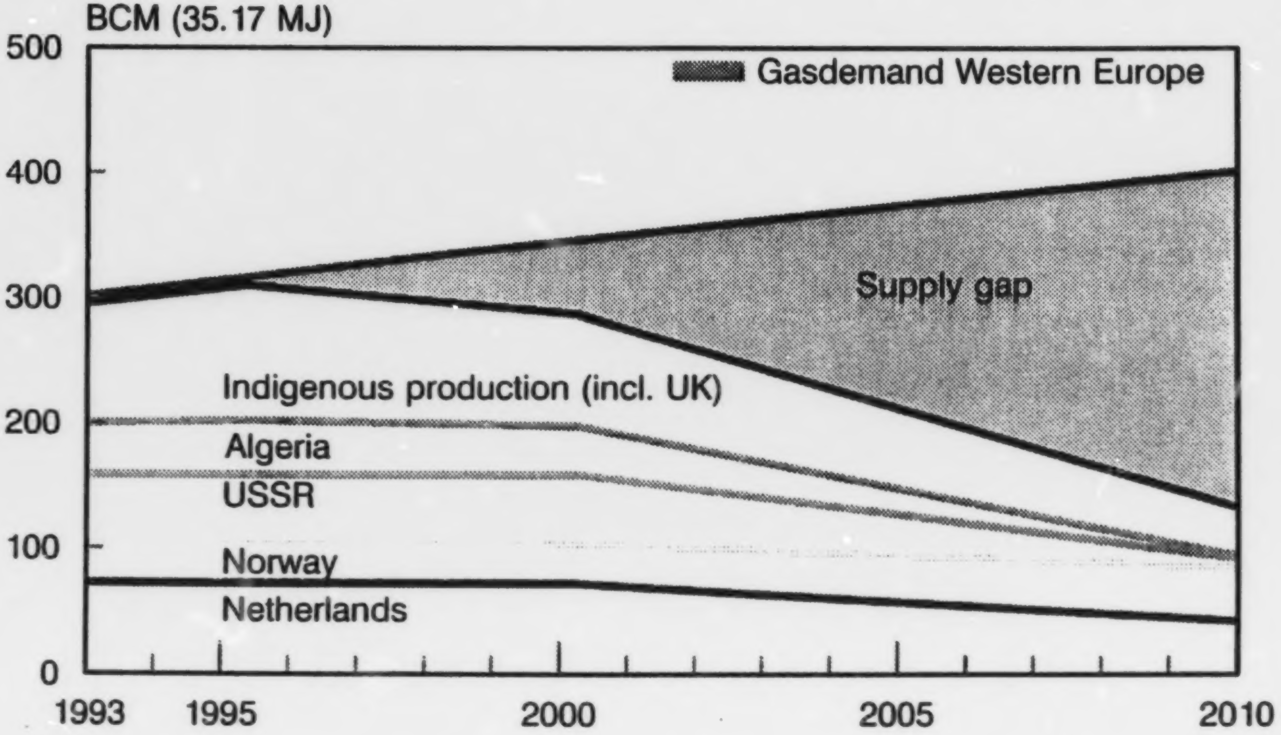
NATURAL GASDEMAND OUTLOOK IN EUROPE

Sept. 1990



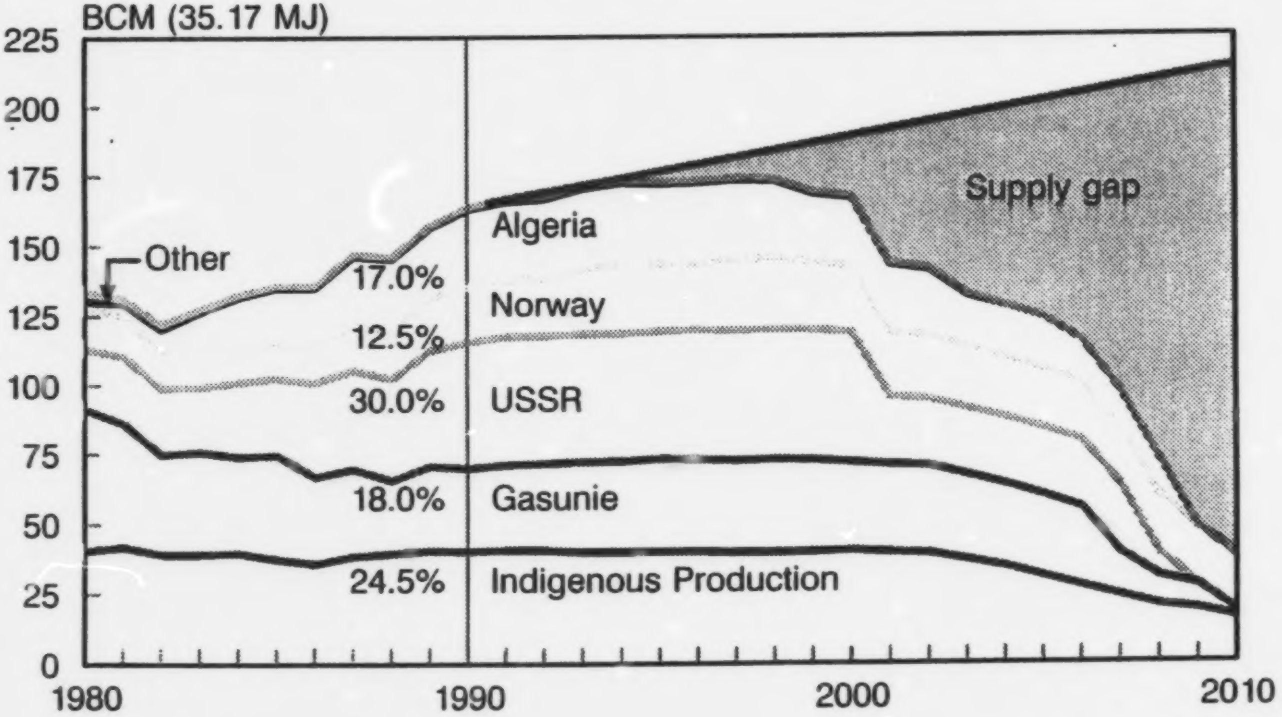
CONTRACTED-GAS VS W-EUROPEAN DEMAND

Sept. 1990



NATURAL GAS SUPPLY EXPORT COUNTRIES
(FRG, France, Belgium, Italy, Switzerland)

Sept. 1990



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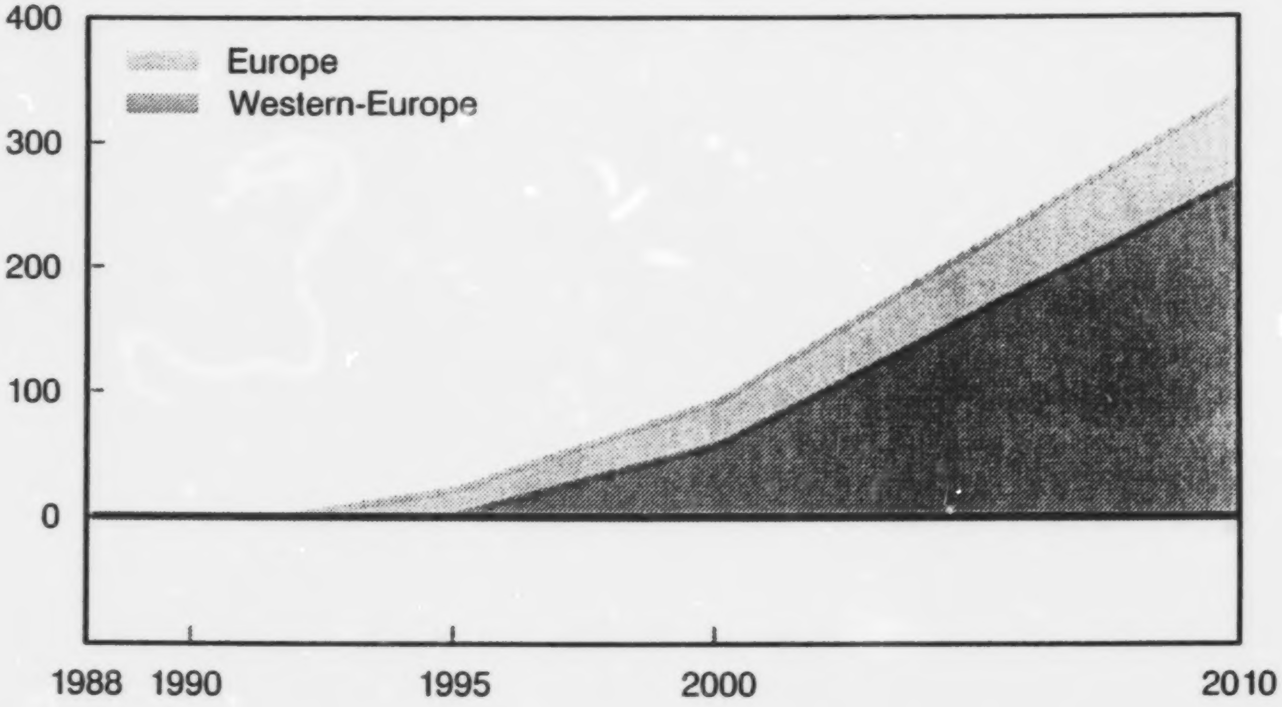
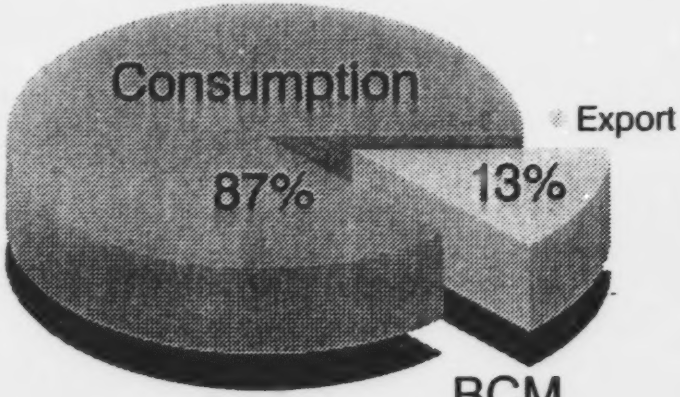
EUROPEAN GAS SUPPLY GAP



Sept. 1990

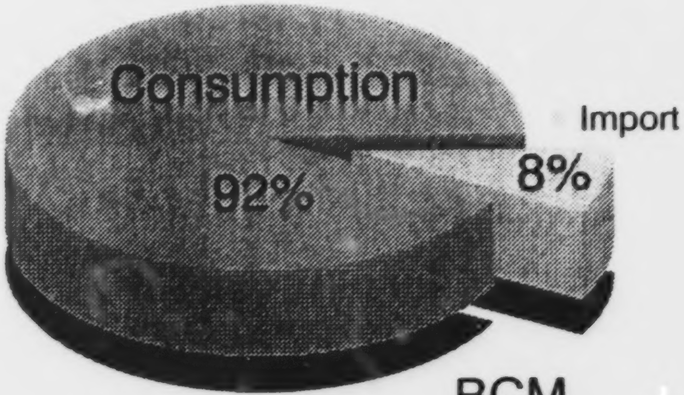
WORLD GASRESERVES 1989

USSR
Reserves 45000



	BCM
Production	800
Export	100
Consumption	700
R/P	55

USA
Reserves 5200



	BCM
Production	510
Import	45
Consumption	555
R/P	10

POSSIBLE SUPPLY SOURCES EUROPE (1)

Sept. 1990

USSR (non EEC)

- Total proven reserves: 45.000 BCM
- Politically and economically unstable situation
- Huge capital investments required in remote area's (Siberia)

Norway (non EEC)

- Total proven reserves: 2600 BCM
- Max. 60 bcm/a to the Continent; 3 offshore pipelines

Sept. 1990

Slide 11

POSSIBLE SUPPLY SOURCES EUROPE (2)

reserves: approx. 3500 BCM
- 25 to 30 bcm/LNG and
  approx. 35 bcm/a pipe line gas to Europe
- Approx. 18 bcm/a LNG to USA?

Nigeria (non EEC)

- Large reserves: approx. 2600 BCM
- Bonny LNG-project from 1995 onwards;
  3.0 bcm/a to Europe and 2.5 bcm/a to USA
- After 2000 extension possible
  (approx. 8.0 bcm/a to Europe)

Sept. 1990

ADDITIONAL SUPPLY EUROPE

- More supplies from non-EC countries and from outside Europe
- Larger distances
- Less security (politically, technically,economically)
- Greater capital intensity of projects
- Longer lead times
- Climate irregularities

Sept. 1990

INLAND SALES POLICIES

- Gas is sold in full competition with mainly oilproducts at burner tip
- Market value concept (net back principle)
- Market load factor
- Long-term contracts
- Security of supply

INTERNATIONAL SALES POLICIES (DUTCH EXPORT)

Sept. 1990

- Gas is sold in full competition with mainly oilproducts at burner tip

- Market value concept (net back principle)

- Long-term contracts

- These contracts are based upon:
  - Sound marketing/efficient operation
  - Reasonable return reseller
  - Periodical renegotiations

NIGERIA'S NATURAL GAS SUPPLY POTENTIAL

Presented by

Dr G S Ihetu

Managing Director and Chief Executive Officer
Nigeria LNG Limited
Lagos, Nigeria

NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
Canada
September 23-25, 1990

Over the last year there has been a surge of interest, around the world, in natural gas, the clean fuel with which Nigeria is so well-endowed. Until very recently this was largely due to a deeper appreciation of the fuel's outstanding advantages, both environmental and economic.

In many developed countries of the OECD, the environmental aspects are perhaps still of prime importance, but current conflict in the Middle East has undoubtedly made people again think seriously about the security of their supplies of energy, especially oil. This will certainly draw further attention to the advantages of natural gas.

Elsewhere, in gas-rich countries such as Nigeria, economic imperatives provide a sharp spur for accelerating the development of natural gas for local use, notably in the efficient and clean generation of electric power to satisfy the rising needs of its people. Nigerians are also keen to raise their standard of living by increasing exports; natural gas is seen as a major long-term opportunity to do this.

This increased awareness of the value of natural gas in terms of the natural environment, economics and security of energy supply has raised the question of where, in the medium to long-term, the gas will come from. As far as both Europe and North America are concerned, that answer can, at least in part, be Nigeria. A four million tonne per annum LNG scheme is at last getting ready for take off and will make its first deliveries in 1995.

The first part of this paper describes Nigeria's advantageous position as a nation not only richly endowed with natural gas but also well-prepared and committed to make it available to those that need it. The second part outlines the exciting prospects for the development of an Atlantic trade in LNG, which in time could compare favourably with that already flourishing in the Pacific Basin.

Nigeria's Gas Reserves

It is well-known that the Soviet Union and Iran have more than 50% of the world's proven gas reserves, and that only fifteen countries between them hold nearly 90% of the known total (see Chart 1). Around the Atlantic Basin there are eight major reserve holders each with a share of between 2 and 5%. Nigeria sits comfortably within this group with proven reserves of 104 Tcf.

Nigeria's proven reserves are larger than those of the Netherlands or Norway and only 6% smaller than Algeria's (see Chart 2). In a North American supply context they are more than half those of the USA, comparable to Canadian and Venezuelan reserves, and larger than those of Mexico.

What sets Nigeria aside in this comparison, however, is the fact that there has been little or no active search for gas itself. Ever since the 1950s when hydrocarbons were first discovered, the search has been predominantly for oil, which is, of course more immediately marketable.

Indeed, for a long time explorers were actually disappointed when, year after year, they found gas instead of, or as well as, oil (see Chart 3). As a result, roughly half the nation's proven reserves of natural gas are associated with oil in hundreds of reservoirs scattered throughout the Niger Delta and beneath the shallow waters offshore. Discoveries of non-associated gas have been confined so far to a comparatively small number of fields, mostly east of the Niger River. Some of these will be dedicated to the LNG scheme in order to provide a secure and comparatively low-cost supply for the initial phase of the project.

Although the potential for further discoveries has not really been assessed on a systematic basis, there are indications that another 70 Tcf could be discovered without much difficulty. This total, of around 174 Tcf, is about the same as the proven reserves of the United States, and is equivalent to roughly ten times its current annual consumption. By contrast, it covers current Nigerian consumption more than a thousandfold.

Nigeria LNG's scheme for a two-train LNG plant producing four million tonnes of LNG per annum over 20 years, will hardly make a dent in the reserves position up to the year 2010, even allowing for a significant increase in domestic consumption during that period (see Chart 4). Nigeria clearly has huge resources that could be exported; it intends to do so as soon as possible.

LNG Project Development

The strong reserves position has of course been known for more than 25 years and it's no secret that several attempts were made in the past to get an LNG project going. But the entry barriers into the LNG business are very high, and Nigeria has had to wait its turn. At last, however, its time has come.

To explain why, it may be helpful to describe the steps required to get a major international LNG scheme successfully off the ground. Many people, especially those who expect an easy and huge increase in the international gas trade to happen within just a few years, do not fully appreciate what is involved.

The main elements in Nigeria LNG's story, which is fairly typical, are;

Reserve evaluation
Project formation
Sales expectations
Economic viability
Financing arrangements
Project implementation

The reserves position has already been outlined above.

Project Formation

Ever since the early discovery of these large reserves, there has been a strong incentive to encourage exploration companies to utilise them as a source of foreign exchange. Under Nigeria's petroleum legislation, foreign companies have the right to develop gas reserves in joint ventures with the National Petroleum Company, and there have never been any obstacles to the release of natural gas for export. Nigeria has an open economy and a legislative framework that encourages participation by foreign enterprises in a well-tried capitalist system. The initiative has lain with the private oil companies, and the commitment is shared with the Government.

The Nigeria LNG Project was informally established in November 1985. It took a significant step forward early in 1987 with the issue of a Prospectus in which the then Minister of Petroleum Resources described it as "a cornerstone for the country's economic recovery and a basis for future prosperity". The Government supported these words by pledging positive support for the project by way of its 60% participation through the Nigerian National Petroleum Corporation. Equally important, it quickly tackled the fiscal and legal aspects which needed attention.

Thus on May 19th 1989, the Project company, Nigeria LNG Limited, was formally incorporated (see Chart 5). The Nigerian Government holds 60% through the Nigerian National Petroleum Corporation. Three major European oil companies, Shell (20%), Agip (10%) and Elf (10%), share the remainder, with Shell also being the Technical Advisor to the Project.

The Project incorporates a two-train liquefaction plant which will process 750 million cubic feet per day of non-associated gas from near-surface onshore fields operated by the Project partners. This will yield more than four million tonnes per annum of high quality LNG for export to Europe and North America.

The Project team is fully operational. A consortium of Technip and Kellogg has almost completed the specification for the LNG plant; the design package for the well-proven Technip/Snamprogetti "Tealarc" process is also nearly ready. Preliminary site preparation work is underway at Finima near the Bonny oil terminal in an area already well-provided with infrastructure and with planned scope for expansion to a five-train operation.

Sales Expectations

Since 1985, all these preparations were made in the belief that the demand for natural gas in both Europe and the USA would expand substantially in the 1990s and beyond, thereby providing the necessary sales opportunity. Project commitments were made in the expectation that it would, and now all signs point to the fact that it is about to do so.

During 1987 and 1988 the pre-feasibility team was encouraged by the enthusiasm shown by a number of major buyers in purchasing Nigerian LNG, both to secure additional 20-year supplies and to diversify their supply portfolio (see Chart 6). Since then there has been a resumption of Algeria's LNG trade into the United States, and a marked quickening of interest among major buyers generally in securing long-term supplies of natural gas.

LNG is not a cheap fuel. Nigeria LNG's customers will be those who recognise its premium value in certain markets. In recent years, we have all become more concerned about the effect of CO_2 emissions on global warning, more willing to take steps to reduce acid rain, and more worried over the cost, safety and decommissioning aspects of nuclear power. At the same time, the development of highly efficient combined cycle gas turbine power stations has provided an environmentally and economically attractive alternative way to generate heat and electricity in many parts of the world. These developments give gas a new lease of life, and lie behind the growing trade in LNG - which now accounts for 25% of international gas sales.

An LNG scheme is a long-term investment for both producer and buyer, and both have to trust each other. This process takes time. Nigeria LNG is now in the final stages of negotiations with buyers. Nigeria will soon be extending the Atlantic Basin Trade in natural gas, with probably 40% of its output going to the United States and the remainder to Europe.

Economic Viability

In the early stages of the Project, with the knowledge that potential buyers had shown encouraging interest in Nigerian LNG, attention soon focused on the task of defining a viable scheme.

It began by re-examining the preliminary cost structure of the Project, with particular interest in the production and transmission of the natural gas, the liquefaction plant, and the shipping (see Chart 7). In this process there was no compromise of technical reliability and safety at the expense of cheaper approaches. Emphasis instead was on how to incorporate the many lessons learned, in particular by Shell, the Technical Advisor, in bringing similar projects on stream elsewhere and on applying particular solutions to specific Nigerian problems.

As a result of these studies, Nigeria LNG is confident that gas can be produced at comparatively low cost. The processing plant includes several radical cost savings, and above all, most of the shipping capacity has been secured on very advantageous terms.

As long ago as 1987, Shell obtained options, on behalf of the Project, to purchase five LNG vessels that had been laid up for a number of years, although hardly used beforehand. These were not worn-out old vessels; indeed the oldest is now a mere 14 years old and the youngest only six. Instead they were surplus to the then requirements of their owners, and were available to anyone prepared to put up the money. As noted above, risks had to be taken at an early stage; this was perhaps the most significant of them all, and so far it seems to have paid off in giving a much needed competitive edge in one of the major capital costs.

LNG 559 and LNG 564 have been renamed LNG Bonny and LNG Finima respectively and are being refurbished prior to servicing other projects until needed by their new owner Enellengee Limited. That subsidiary has also purchased the Gastor and Nestor which will be similarly treated. Much to everyone's surprise and disappointment, the fifth vessel (the Gamma) became the subject of litigation with the Maritime Administration of the United States. This issue will probably be resolved soon and plans are being made to provide for a sixth vessel, a new-build, which will be needed to transport the full plateau volumes.

These vessels, the plant design, and the low cost of producing the gas allow Nigeria LNG to offer gas at prices that customers are now beginning to regard as feasible. These reduced costs help to overcome part of the penalty Nigeria pays by being further from customers than competing suppliers. Cost reduction has been a crucial objective, and the company is confident that prospective customers will recognise the very significant effort put into this element of the Project.

Financing Arrangements

At first glance, it might seem an impossible task to finance a $2.5 billion scheme on a non-recourse basis in Nigeria (see Chart 8). However, four elements will ensure a successful financing;

> firstly, with its shareholders, Nigeria LNG has an enormously strong team with a track record of success,
>
> secondly, the Project will be economically viable,
>
> thirdly, it has the full support of the Nigerian Federal Government, and
>
> finally, the innovative, pragmatic financing plan is highly attractive to the international financial community.

It is envisaged that the finance package will include commercial bank loans, debt conversion, local funds, export credits, loans from multilateral agencies, and of course equity. Discussions have been held with members of the banking community over a two-year period, and there is confidence that project finance will be available on attractive terms in time for a commitment decision during 1991.

Project Implementation

It is intended that a Main Contractor for the engineering, procurement and construction of the plant and associated facilities be appointed during 1991 with first deliveries of natural gas some four years later (see Chart 9). Thereafter there will be a rapid build up to a rate of three million tonnes per annum within 18 months and to the plateau level of four million tonnes per annum over the following six months.

The implementation of this, Nigeria's first LNG export project, has already been a long process and it is not yet complete. There have of course been difficulties, as only to be expected in a complex project of this nature, but on balance there is reason to be extremely pleased with the progress made since 1985. The problems have been fairly typical of those faced by other greenfield LNG projects, and Nigeria LNG's experience is a reasonably good example of the time and effort that it takes to introduce a new project. Once started, however, expansions and additions become that much easier and quicker, and the company's ambition is to expand significantly as soon as the Atlantic Basin demand will allow.

The Atlantic Basin LNG Trade

Around the world, only eight nations export LNG (see Chart 10). Indonesia is the largest and history shows that, having entered the Pacific Basin Trade, its producers were able to introduce new capacity steadily over the years as trade expanded. New entrants found it difficult to gain entry, but once inside, Malaysia, for example, is also now confident of substantial expansion. Furthermore, after the base load business had been established in Japan, it then became feasible for both Korea and Taiwan to develop their own LNG import facilities.

The market for Nigerian LNG is of course the Atlantic Basin, where circumstances are somewhat different from those in the Pacific Basin (see Chart 11). The pattern of development could nevertheless become rather similar in time.

The natural gas business in both Europe and North America is a mature one that grew mainly on the basis of indigenous or very nearby sources. These are far from exhausted, but European consumers rely ever more on imports from the Soviet Union and Algeria, and it hardly needs pointing out how the United States is increasing its imports of natural gas from Canada.

Looking back, many people can recall that prospects for the rapid development of LNG imports into the USA seemed even brighter two decades ago than they seem today. For many years the legacy of that optimism sadly included some 30 million tonnes of mothballed LNG import terminal and regasification capacity along the eastern coast, some 5-10 million tonnes of underutilised liquefaction capacity in Algeria, and numerous expensive ships lain up for many years. LNG is indeed a risky business.

Nigeria LNG deliberately therefore set itself a modest entry target. The plant has only two trains, but provides for the easy addition of three more. Sales will represent only a small, maybe 4%, share of the customers' portfolios. Existing import terminals and regasification plant will be used, and significant capital cost reductions will be achieved by starting off with existing LNG carriers.

The company firmly believes that the demand for natural gas will continue to increase more steeply in Europe. The proven reserves of natural gas in the United States continue to decline, and the northeastern part of that country is facing supply shortages. In this latter context it is interesting to note that others with this view contemplate building an LNG import terminal in Quebec to supply the same region with regasified LNG via pipeline.

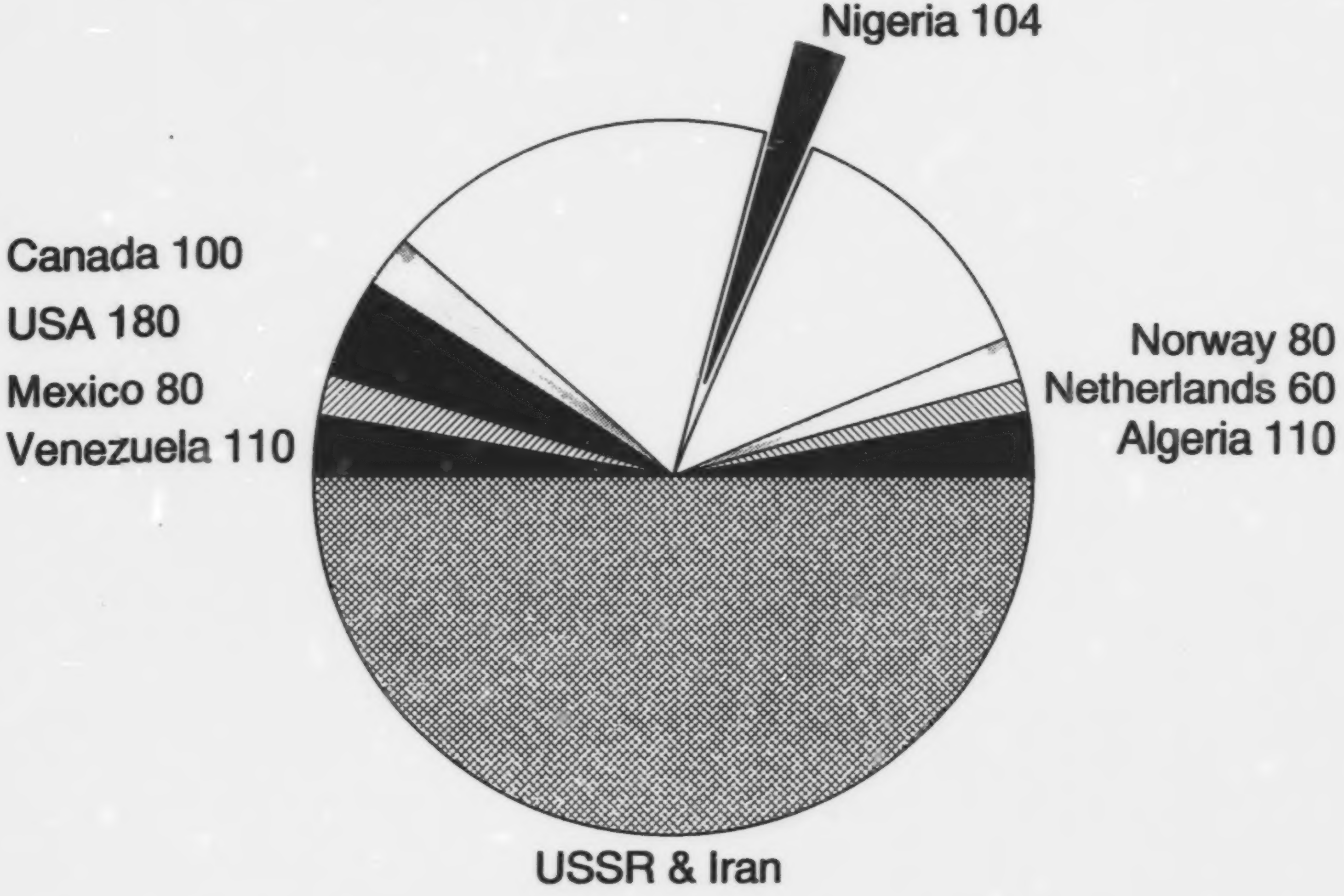
On the competitive front, a Venezuelan LNG project team has recently been created; by contrast the proposed Gullfaks scheme to export LNG from Norway to the USA has been postponed indefinitely, although there is now talk of a plan based on the Snoehvit gas field. On the European scene, Sonatrach are steadily refurbishing much of their LNG production plant and discussing additional or new supplies to a number of countries.

There are therefore hesitant signs of what could be a prolonged blossoming of the Atlantic trade. Nigeria LNG is developing a commercially and technically sound scheme for the competitive supply of LNG into the European and American market. Although the distance from Nigeria to the markets of North America and Europe cannot be shortened, everything possible has been done to lower the cost of getting LNG along those routes. The company firmly believes that its product is good value, it is confident that the cost structure is about right, and it is optimistic that its timing is favourable.

As for the future, it is well to remember that Nigeria has tremendous comparative strength in terms of gas reserves. Once our first phase is underway Nigeria LNG will be ready, willing, and able to add more and more facilities so as to play a major part in the developing Atlantic Basin Trade.

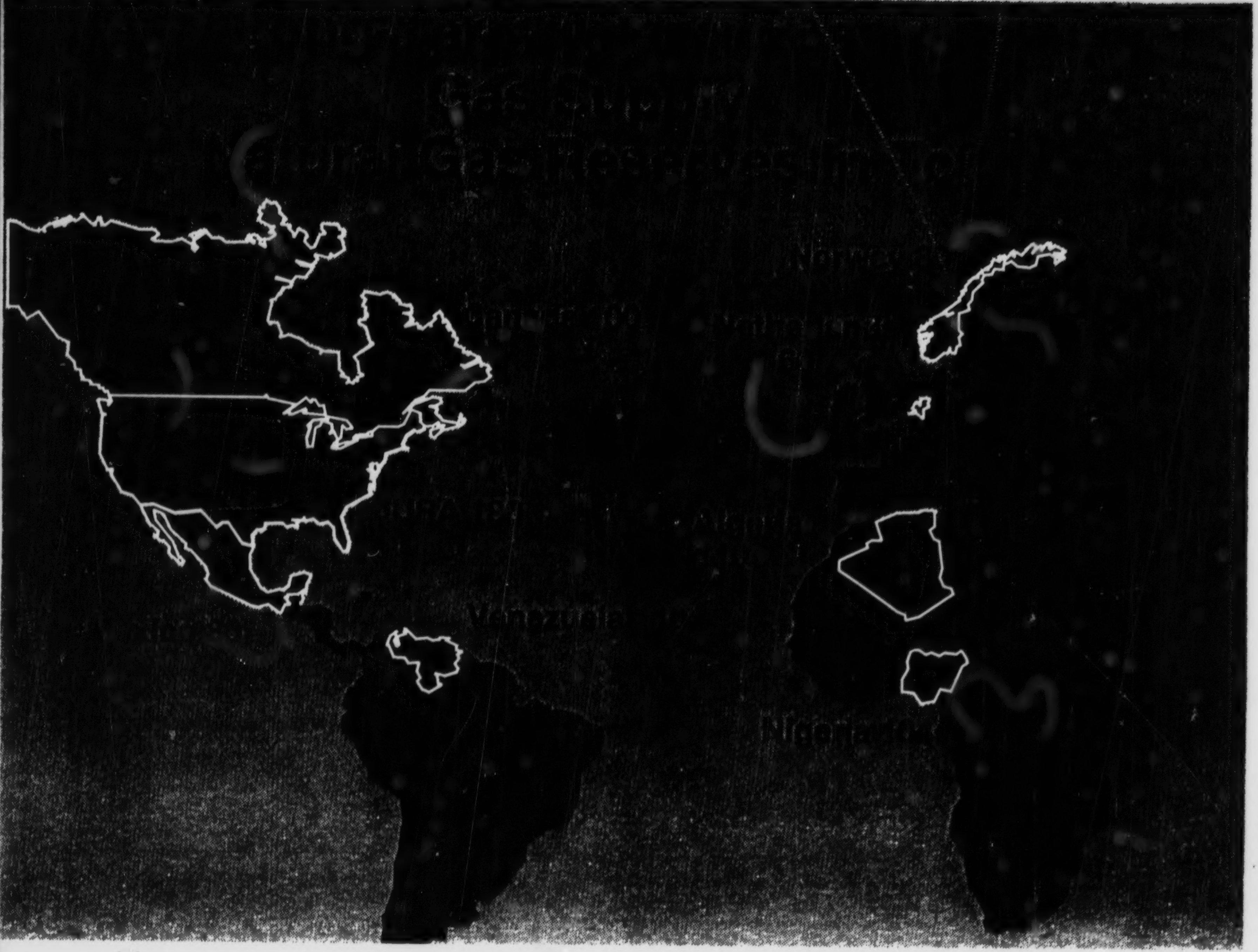
Chart 1

World Proven Gas Reserves (Tcf)

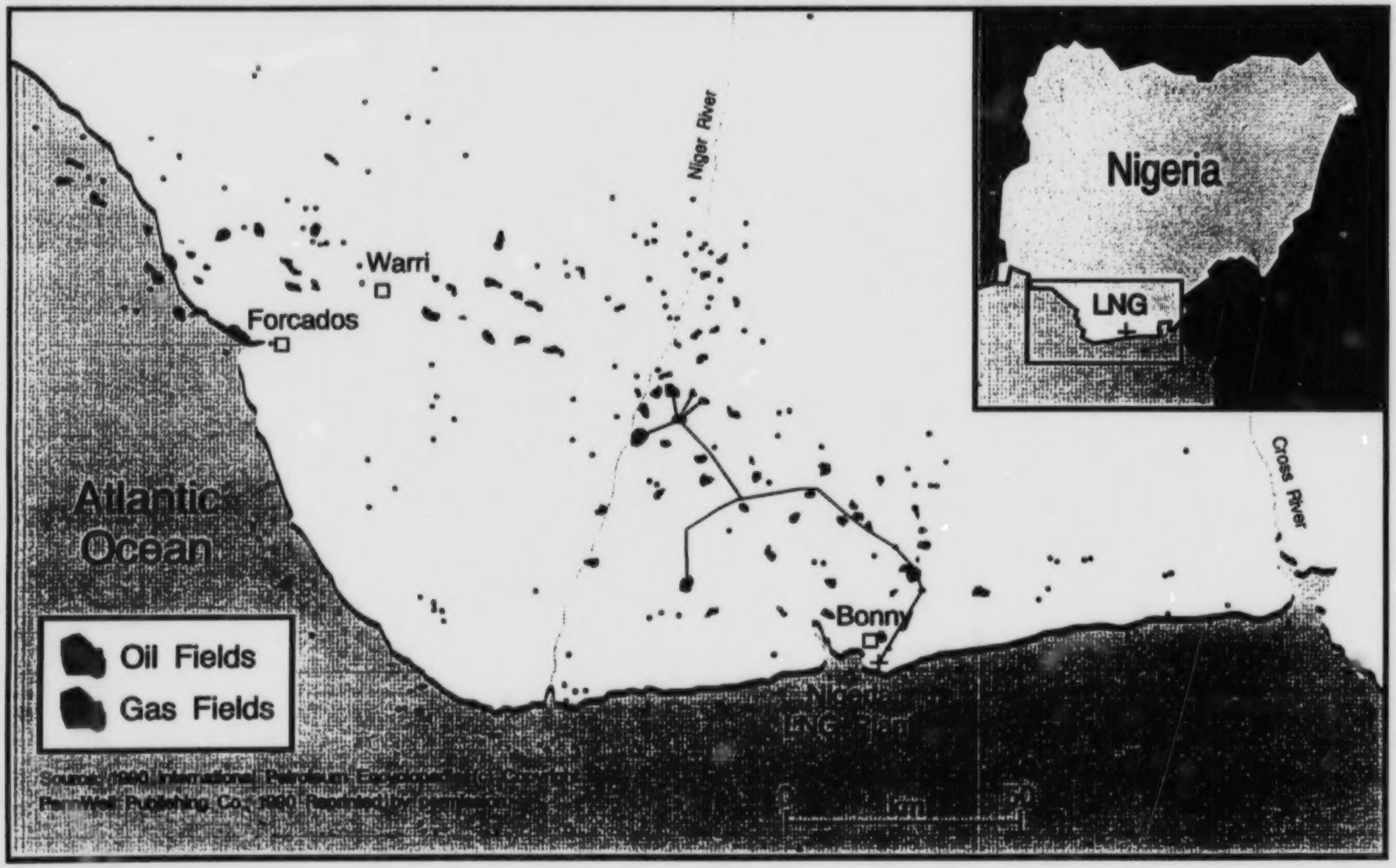


World Total 4000 Tcf at 1.1.90

Chart 2


Venezuela
Nigeria

Oil and Gas Fields of Nigeria


Nigeria
LNG
Niger River
Cross River
Warri
Forcados
Bonny
Atlantic Ocean
Nigeria LNG Plant
0 km 50
Oil Fields
Gas Fields

Source: 1990 International Petroleum Encyclopedia (c) Copyright PennWell Publishing Co., 1990 Reprinted by permission.

Call on Nigeria's Proven Gas Reserves

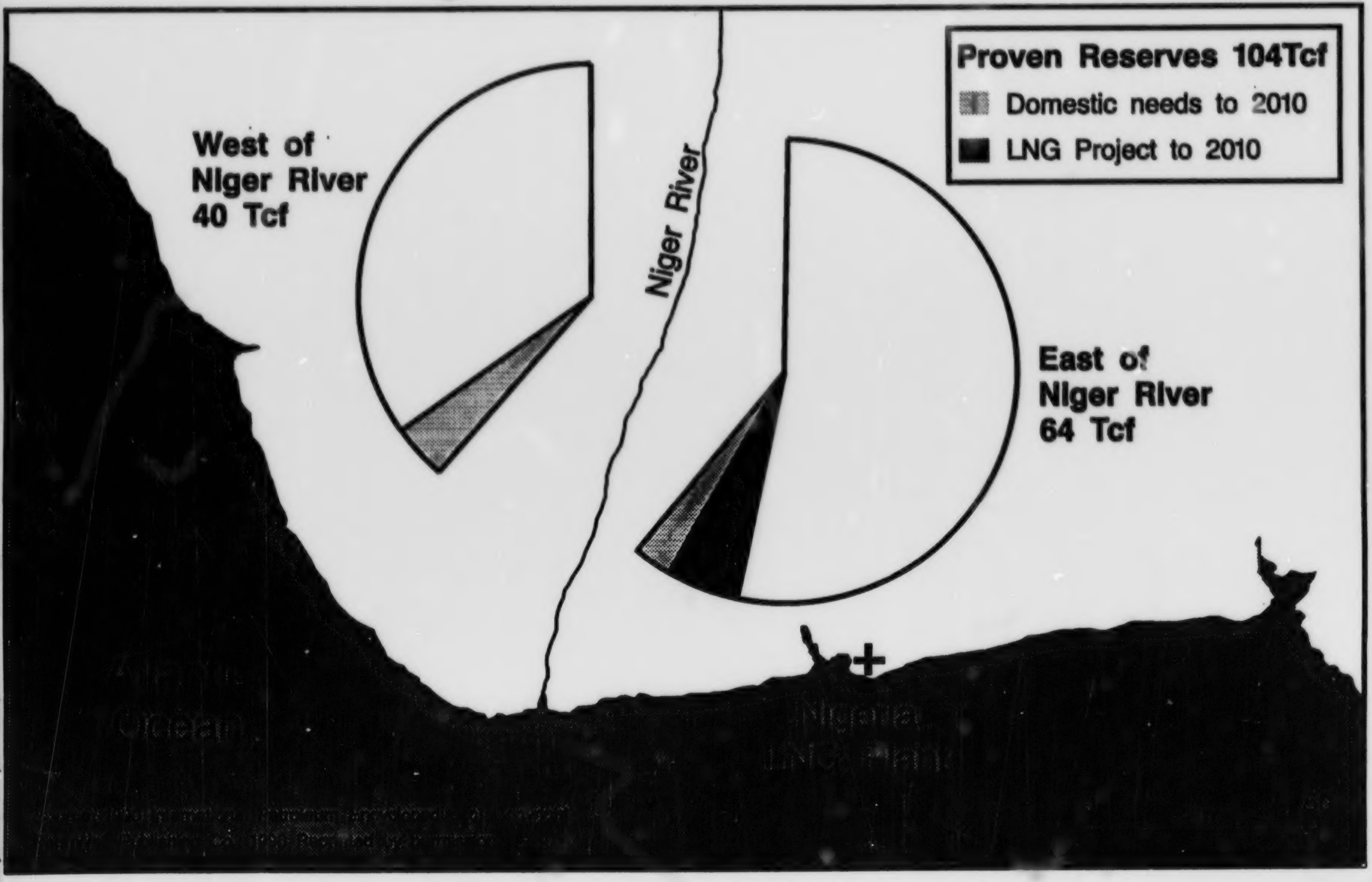
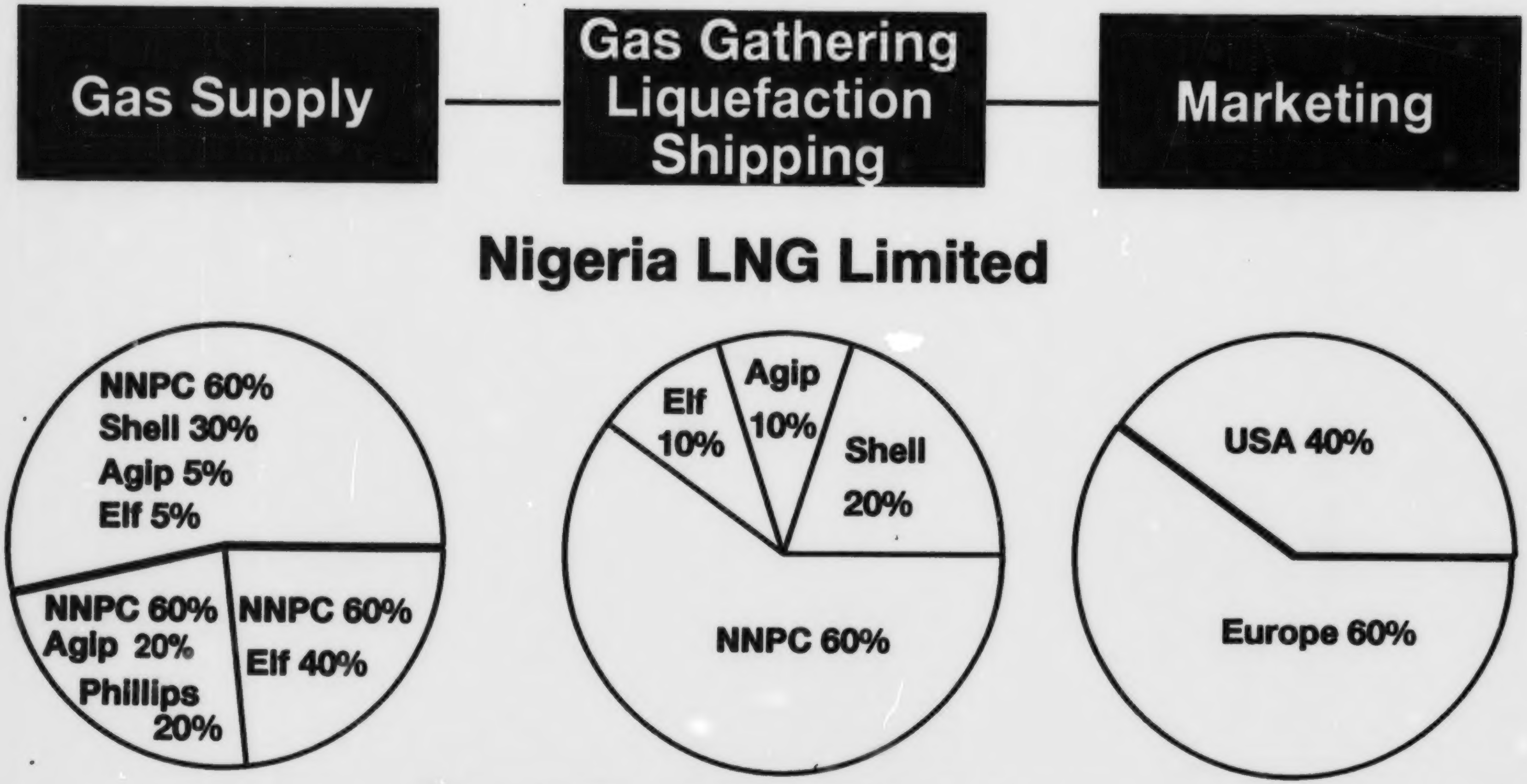

Proven Reserves 104Tcf
▨ Domestic needs to 2010
■ LNG Project to 2010
West of
Niger River
40 Tcf
Niger River
East of
Niger River
64 Tcf
Atlantic
Ocean
Nigeria
LNG Plant

Chart 4

Nigeria LNG Project Structure



Nigeria LNG Limited

Shell Technical Advisor

Chart 5

Nigeria LNG Customer Interest

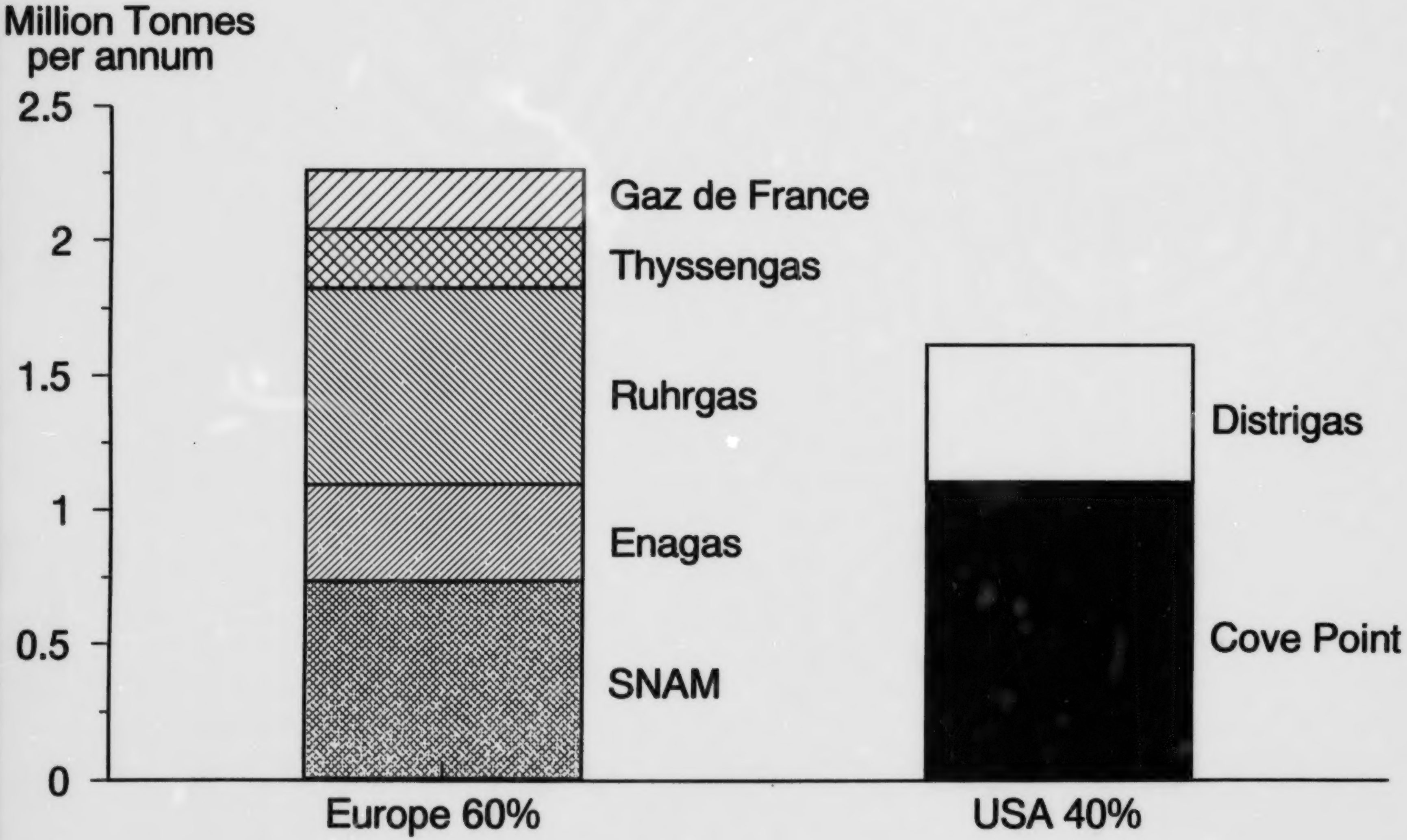


Chart 6

Nigeria LNG Capital Cost Savings

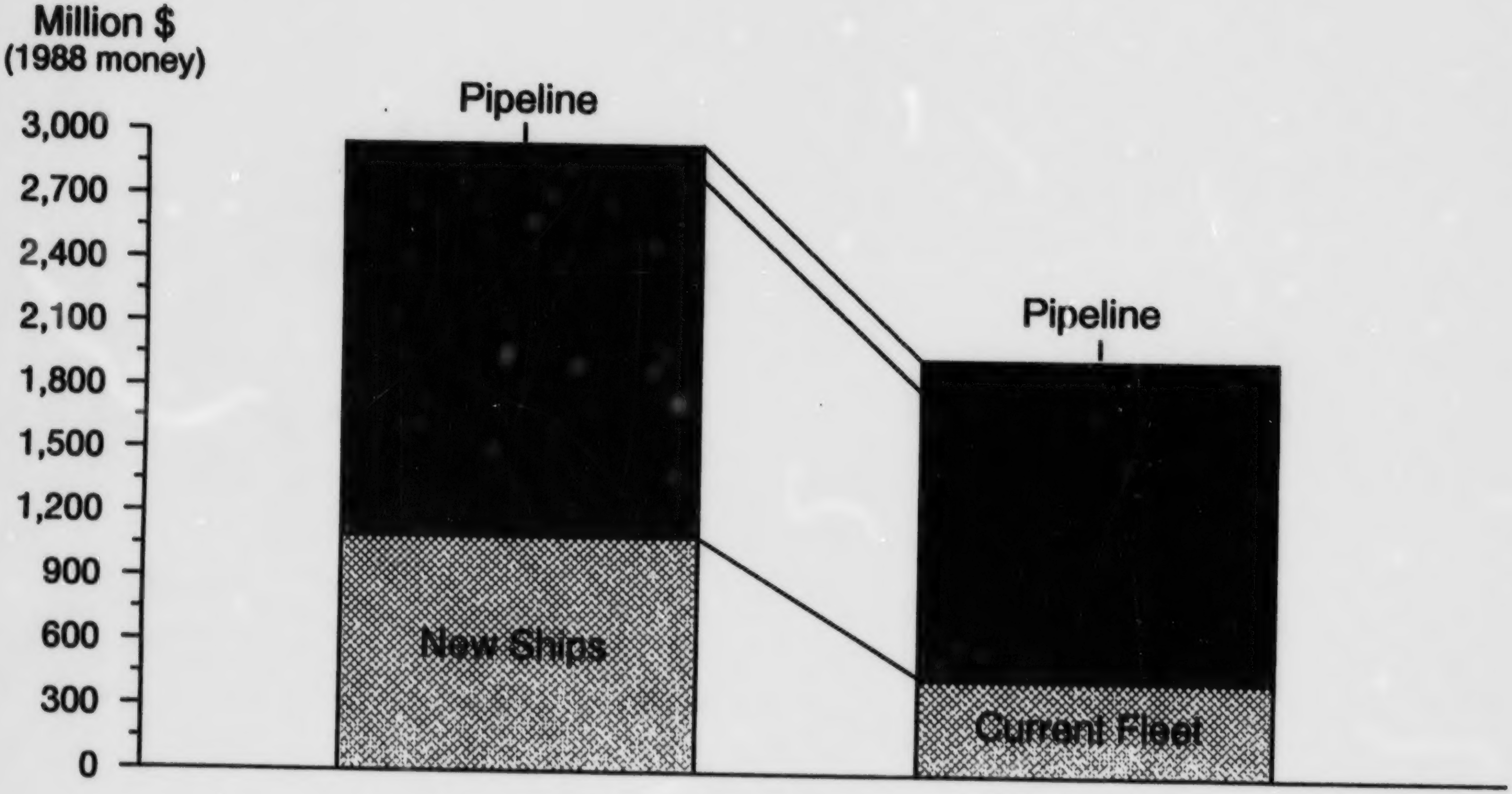
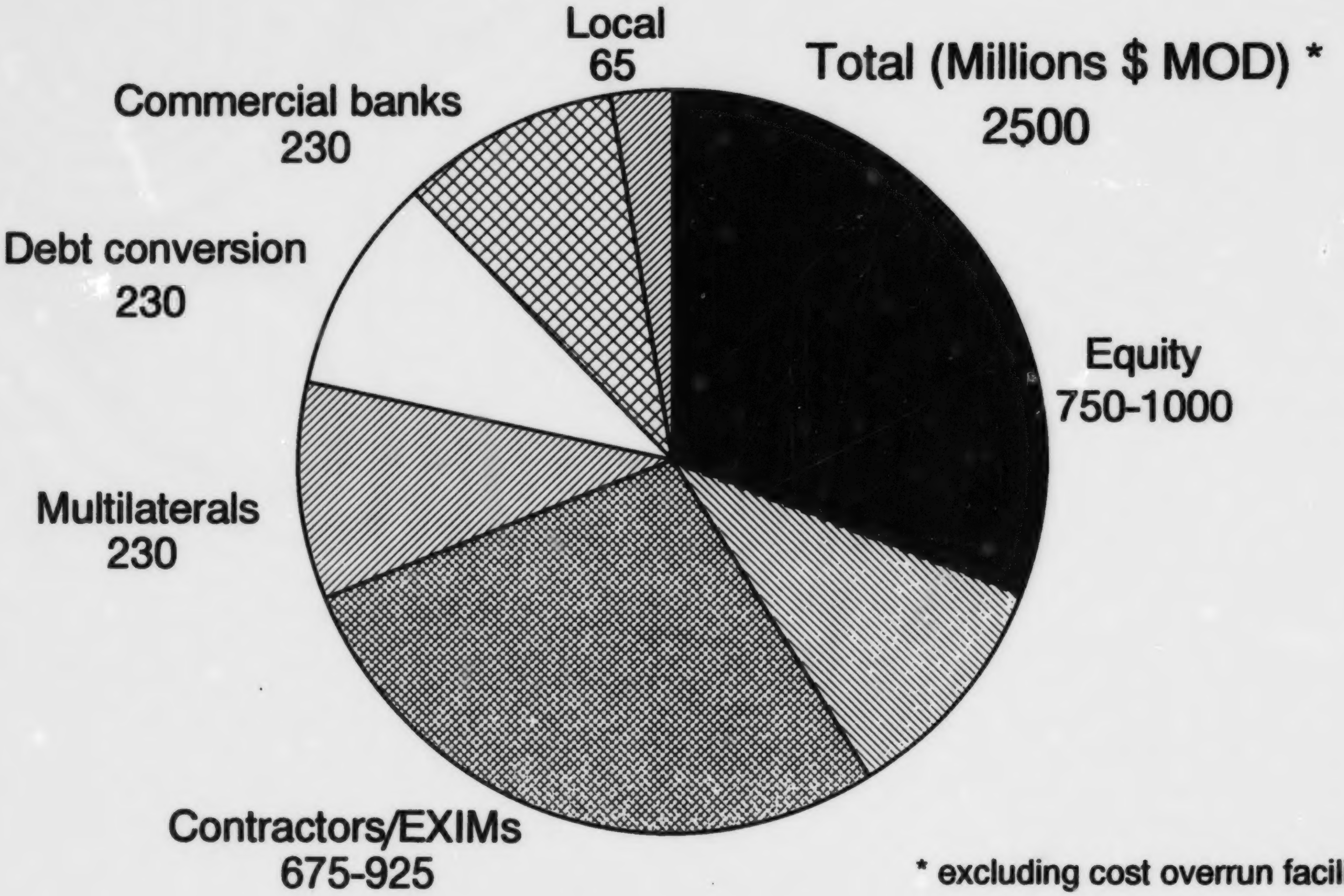


Chart 7

Nigeria LNG Probable Financing Structure



* excluding cost overrun facilities

Chart 8

Nigeria LNG
Project Development Schedule

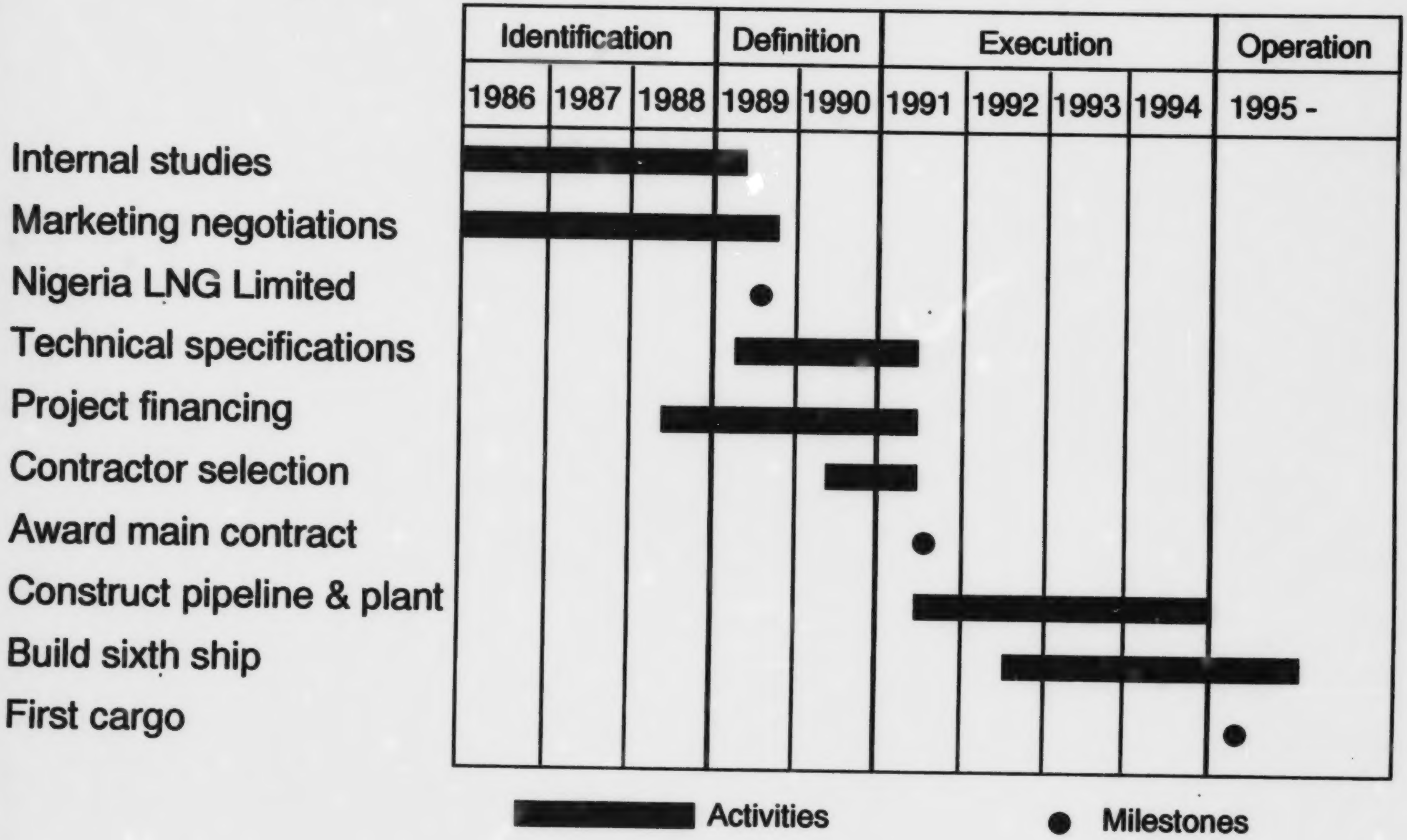


Chart 9

Chart 10

World LNG Capacity Introduction

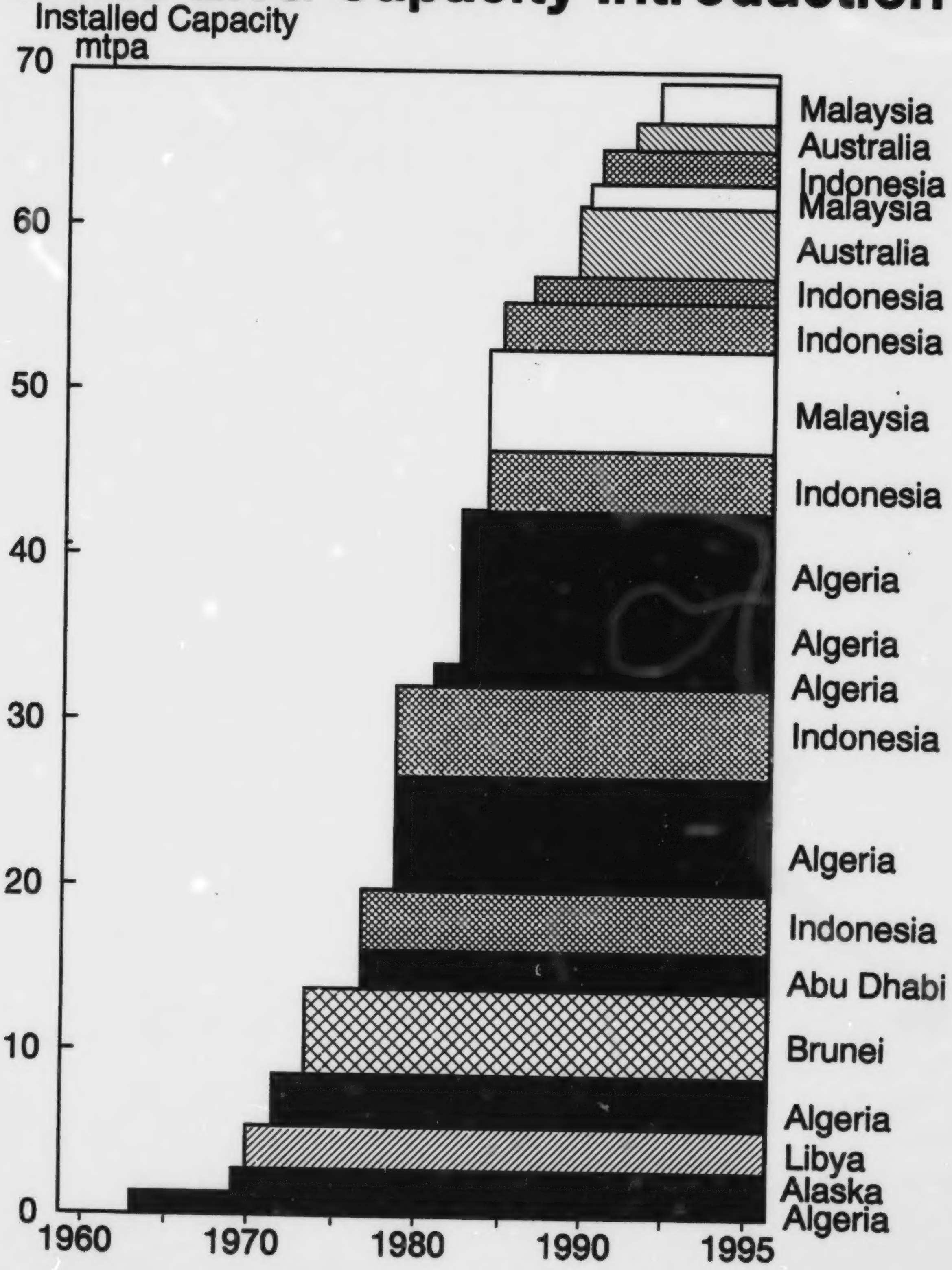


Chart 11

THE PACIFIC BASIN LNG TRADE: A RETURN TO FUNDAMENTALS

Presented by

Drs. H. Baharuddin
Director for General Affairs
PERTAMINA
Jakarta, Indonesia

NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

It gives me great pleasure to be here with you today to share some of Pertamina's current thinking on the LNG trade in the Pacific Basin, and to speculate with you on where this business may be going in the future. Before I do so, however, I want to thank the Canadian Energy Research Institute for inviting Pertamina to again exchange views with other international groups and organizations about the challenging tasks facing us as gas marketers.

Even though representatives from Pertamina and the Indonesian Government have participated in the CERI conferences in past years, this is the first time I have attended one of your functions. I wish to commend your conference organizers for doing an outstanding job on the arrangements and logistics for this meeting. It has been an excellent conference so far, and I have appreciated the opportunity to discuss various aspects of the gas business with the other conference attendees. Also, it is a personal pleasure for me to visit Calgary again, as I enjoy very much the beauty of this part of Canada.

To set the stage for my remarks this morning, I would like to spend just a few minutes to outline some general information on Indonesia, and our activities as an oil and gas producer.

Indonesia is an archipelago (Slide #1), the largest in the world, consisting of five large islands and some 13,000 smaller ones. It stretches some 3,500 miles between the Asian Continent and Australia, with an aggregate land area of about 785,000 square miles. This land area represents about 25 percent of the total area of the archipelago, since 75% of our territory is water (Slide #2). We have a population of over 180 million people; the fifth largest country by population in the world, and the second largest - behind China - in the Asia-Pacific region. Our 1990 GDP is expected to be U.S.$125 billion, four times the 1970 level of U.S.$31 billion, expressed in comparable dollars.

Indonesia has been in the oil and gas business for a long time. We celebrated our oil centennial in 1985, marking 100 years since the first commercial discovery was made on the island of Sumatra in 1885. Modern Indonesian oil history only started, however, about 25 years ago with the emergence of what we call "The New Order". Production capacity at that time was 515,000 barrels per day. Our capacity has since increased almost threefold, and known recoverable reserves today are also about three times larger than they were 25 years ago (Slide #3).

As part of the rapid development of our oil and gas business during the last 25 years, huge gas discoveries have been made in various parts of Indonesia, particularly in North Sumatra, East Kalimantan, the Natuna Sea area, and the Madura Island area in East Java. Current estimates are that we have some 91 TCF (2.4 Trillion cubic meters) of economically recoverable gas in these areas (Slide #4).

Indonesia has developed LNG export facilities at Arun in North Sumatra and at Bontang in East Kalimantan. Exports of LNG to Japan commenced from Bontang in 1977 and from Arun in 1978. LNG exports from Indonesia have now grown to over 20 million tonnes per year with shipments to Japan, Korea and Taiwan; our newest customer, the Chinese Petroleum Corporation began taking LNG earlier this year (Slide #5). We are the largest exporter of LNG in the world today, and, with the continued help, cooperation and mutual recognition of the realities facing the LNG business - by both Indonesia and its customers - we hope to keep this market position.

Let me emphasize and expand very carefully on my point about cooperation and recognition of the realities of the LNG business. The LNG business in the Pacific Rim has always been based on what we term mutual buyer/seller cooperation, and mutual buyer/seller recognition of the financial and commercial challenges faced by all links in the LNG supply chain. This is unique in the energy business; but LNG is a unique business. There is no other source of energy, that I know of, in which buyer and seller sign contracts for 20-year periods. Quite simply, the

LNG business in the Pacific would neither have gotten off the ground in 1969, nor could it have been sustained without interruption over the past two decades, if there had not been the willingness of all the buyers and sellers to recognize the unique nature of this business, and to cooperate in the sharing of risks and rewards, particularly during the changing marketing conditions that we have experienced during these past 20 years.

When we look to the future of LNG in the Pacific, I can only see that - far from it ever becoming a faceless commodity, like crude oil, moving in blips on a trading screen and changing hands between strangers - LNG will require an even more conscious and cooperative commitment by every element in the supply chain that takes it from reservoir to the burner tip. Let me elaborate on this point.

Before the first drop of LNG can be delivered, vaporized and burned, a formidable supply chain must be put in place from wells to gathering pipelines; to liquefaction plants; to ships; to storage tanks; to new power stations and to new gas distribution systems - all of which will largely be sized and dedicated to a specific LNG project to reduce costs. Therefore, once implemented, you cannot pack up your hardware and take it elsewhere. This is the physical LNG chain, and it requires a great deal of investment.

The commercial LNG chain brings the physical chain to life and keeps it from being a heap of idle, very expense capital junk. The commercial chain is based on long-term relationships between a surprisingly small number of companies. Inside one of these chains, gas and money flow along the chain and the combined impact of the respective investments will produce a reward to be shared by all. If cooperation doesn't exist between companies in the chain, no one will benefit. "Us and them" concepts have no place in this reality, and a great deal of give and take is required. I should emphasize that the "give" is often as painful, as the "take" is pleasant.

To the pioneers of the LNG business, none of this would be news. They would consider it plain common sense. But I think we need to remind ourselves, particularly in today's environment, that these principles are not only just as valid today as they were then, but are probably more so. Why do we need to be reminded of the obvious? I think it is because the ebb and flow of LNG prospects over the last decade have blurred our collective memories. There are an increasing number of people in the LNG business today, it seems to me, who say that LNG is just another commodity, so that there is no longer the need for strong, sound, well-integrated LNG chains to be forged between buyers and sellers. Let me elaborate further.

In 1986, when the world LNG trade representatives gathered in Los Angeles at the LNG-8 Convention, a general mood of pessimism hung over the proceedings. Even the imminent opening of the Pacific's second LNG trade - our own exports to Korea - did not excite the delegates very much because this contract had been signed in 1983. The U.S.A. had its entire receiving capacity sitting idle, and in that same year, for the first time in the decade of the 1980s, the world total of delivered LNG fell below the preceeding year's level. It was a gloomy situation.

Indonesia signed a short term LNG sales contract in 1987, and two more in 1988, but these - as important and valued as they were and are to both us and our customers - were but additions to existing supplies, using existing liquefaction, shipping and receiving terminal capacities. The questions were still there - where was the LNG business? What had happened to the potential and opportunities for one of the world's cleanest and most attractive fuels? What was going on? No one seemed to have any answers.

Then the industry gathered, just three years later in 1989, in Nice at LNG-9, and optimism abounded. It was as if, almost overnight, there had been a recognition that economic growth was indeed increasing, that there was a tremendous need for new energy supplies, and that natural gas - a lot in the form of LNG - was going to be an important source of energy for this expanding demand.

Projects began to come out of the woodwork - the press was full of talk about Alaska, Nigeria, and Qatar; additional grass roots plants in Australia; expansions in Indonesia, Malaysia, Brunei, Abu Dhabi - all aimed at supplying a market that everyone agreed was there, and one that had to be filled to a large extent by gas.

There were greenhouse and pollution effects and concerns; tremendous increases were forecast in power generation demands which, using the new technology of combined-cycle gas turbines, made gas as economic as any fuel around; the LNG safety record was impeccable, particularly when compared with the record of nuclear plants. In short, the future never looked better for LNG.

That mood persists today, and in the euphoria it is perhaps natural to forget how the Pacific LNG trade was so successfully managed during the last two decades. Forgetting these early days, people started talking immediately about a new generation of LNG sales contracts; a second frontier so to speak, of LNG growth that was going to be so much easier now that LNG was a cheaper, mature commodity, and so much new demand potential had been identified.

Consumers and producers came forward to define their respective and individual views on what it was going to take to bring about this second frontier of LNG growth. These views, and the approach to them, were amazingly unrealistic it seems to me, because they completely ignored the fundamentals of the trade that had been so laborously, and sometimes so painfully, developed in the projects that were implemented during the first frontier of the Pacific Basin LNG trade.

For instance, the buyers (Slide #6) said that new contracts would have to be more flexible; provide for more swings in demand; contain less restrictions on take or pay clauses; provide more relief from performance through broader and broader force majeure clauses; have more open-ended options on capacity; contain price reopener clauses; or have floor and ceiling prices; provide for less than full escalation of energy costs, and, finally, please realize that LNG had to be even cheaper than it is now, so as to be more competitive with quote those-other brand-X-fuels unquote.

Producers (Slide #7), on the other hand, said that plant operating and investment costs were going up; financing is still a problem; upstream gas suppliers need greater and greater incentives to develop the gas fields because of lower prices, and what about transportation?

That is still a big problem, and getting bigger because new ships are a lot more expensive today than existing shipping, so - who is going to pay these additional costs? How are these costs to be allocated?

Not to the buyers, came the answer; they began to insist that transportation was a supplier's problem, even in FOB contracts.

Do these comments sound familiar? I have heard more and more similar statements as I have talked over the past 12 months or so with producers and consumers throughout this business. This disturbs me. It sounds like both groups are beginning to lose sight of the fundamentals of this business.

Whatever happened to the LNG chains that were forged together in the old days to successfully create the current projects? Today I hear more and more about only the various links in the chain, with each link trying to get another link to accept more than a reasonable or economical share of responsibility in order to meet some individual economic objective, or to achieve some isolated benefit. I don't hear much these days about the whole LNG chain.

This, in my view, is a very serious situation, and one that needs to be addressed quickly by everyone in this business, because herein, I believe, lies the key to future development and sale of natural gas as LNG in the Pacific Basin.

It is only through continuing to recognize the need for cooperation all along the gas chain, and acting accordingly, that buyers and sellers can hope to sustain the past successes that have marked the growth of the Pacific LNG trade. Furthermore, these are the same cooperative fundamentals which have existed from the beginning, and they are still required to achieve the potential growth in LNG trade for the energy markets of the future, as everyone now sees them to be developing.

Anyone who today thinks this second frontier of LNG demand will arrive without an even greater cooperative effort than was needed, for even the best examples of the past, has to contemplate a return to the mid-80's with LNG going nowhere. If this is the case, then this second frontier just won't arrive.

It won't arrive, ladies and gentlemen, because nothing has changed (Slide #8) in our business - it still has all of the same old, difficult characteristics it used to have. We still have to forge a chain, together, through - and I repeat again - help, cooperation, and a mutual understanding and recognition of the fundamental realities of the LNG business by both buyers and sellers.

Customer demand is there, again; gas is still a superlative fuel, particularly for the future, and the consuming countries must give it a significant long term role in their energy mix; they cannot avoid it.

The producers still have very large and very long term financial commitments to satisfy, both in terms of gas field development as well as liquefaction plant construction; new ships are expensive, and getting more so; costs are on the increase, for everything - including new receiving terminals.

In short, far from this being the golden age of LNG in the second frontier of tremendous growth, we are at the border of a fragile and very sensitive expansion opportunity where whole new LNG chains - not links - will have to be forged together by buyers and sellers if the potential for LNG expansion is to be realized.

If we are to go forward, particularly into the vast expansion opportunities offered in the Pacific Basin, buyers and sellers must do it together - just like the old days. Requests for any one link in the chain to carry the cost burdens, or the burdens of hard times, or to pay a premium under all circumstances, just won't work. Let's go back to the fundamentals of the LNG chain, and stop trying to forge isolated links which are sub-optimized through shadow economics for that link only.

It would be well for gas buyers in the Pacific to remember, also, that marketing of gas reserves in Malaysia, Thailand, Indonesia and Australia is no longer limited to or constrained by LNG supply/demand factors. In other words, LNG is no longer, necessarily, the "only show in town" (Slide #9).

The profitable development of gas for domestic markets in these countries, by governments as well as major international oil companies, is increasing significantly. While volumes of gas being sold in these domestic markets are admittedly small when compared with export volumes being sold to, and the potential of, the export LNG markets, it is expected that the pace of domestic gas market development will increase significantly in the coming decade, and into the next century.

Thus, in the future, gas producers in the Pacific Basin will have increasing alternative investment opportunities for marketing their gas. This is a reality that needs to be carefully considered by both producers and consumers in the gas business in the Pacific Basin.

Natural gas, whether it is used locally, piped to neighbors, or shipped great distances as LNG, has a great future in the Pacific today (Slide #10). I encourage those in this business to preserve its best traditions to realise this promise. I look forward to cooperating with like-minded families of companies and government policy makers undertaking that challenge today, or planning to do so later in the promising future facing our business. But let's stubbornly hold on to the old fundamentals of the LNG business, because those are what brought us to Calgary, today.

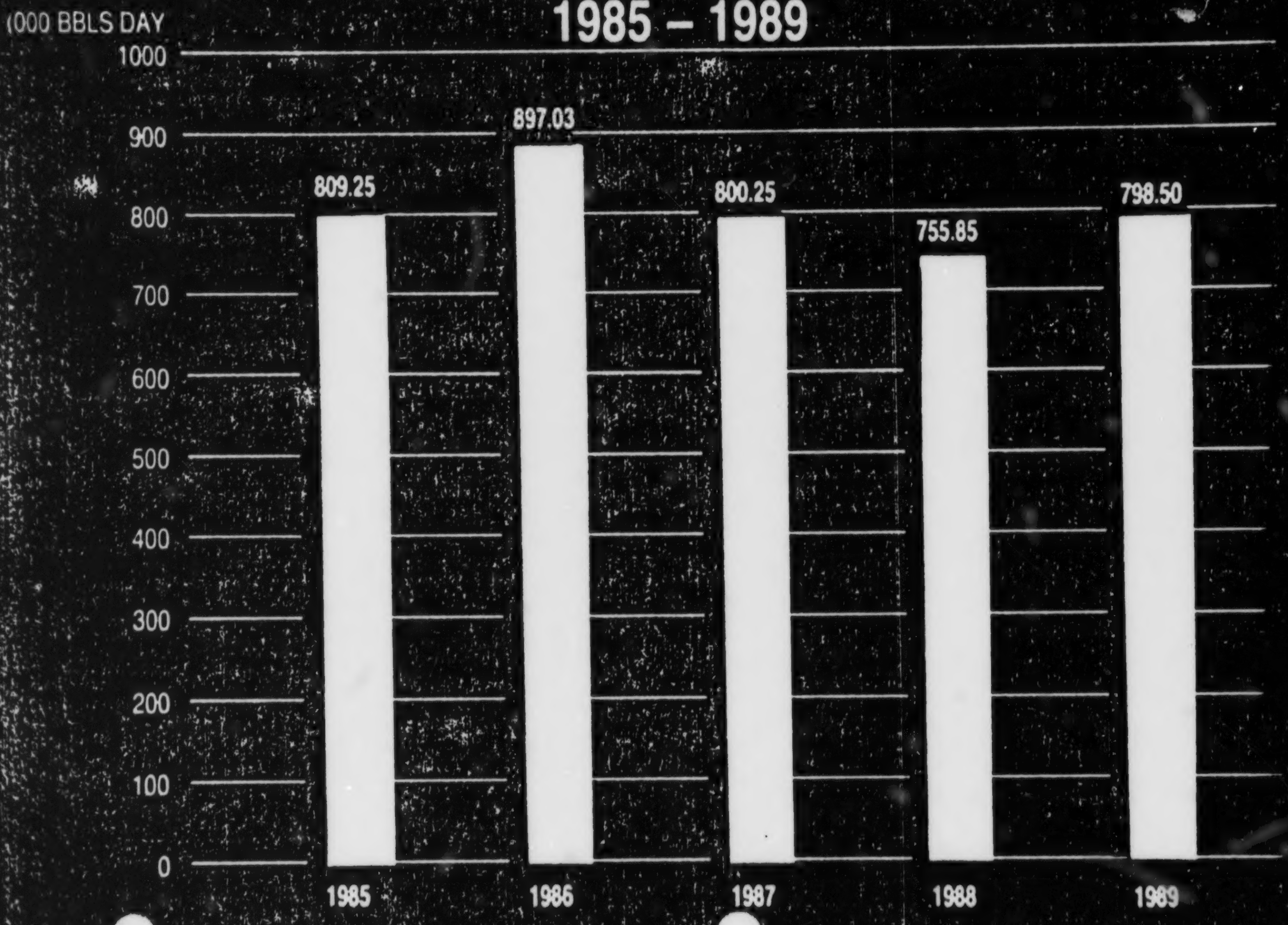
Thank you for your attention.

INDONESIA
PACIFIC OCEAN
SULAWESI
JAKARTA
BALI
INDIAN OCEAN

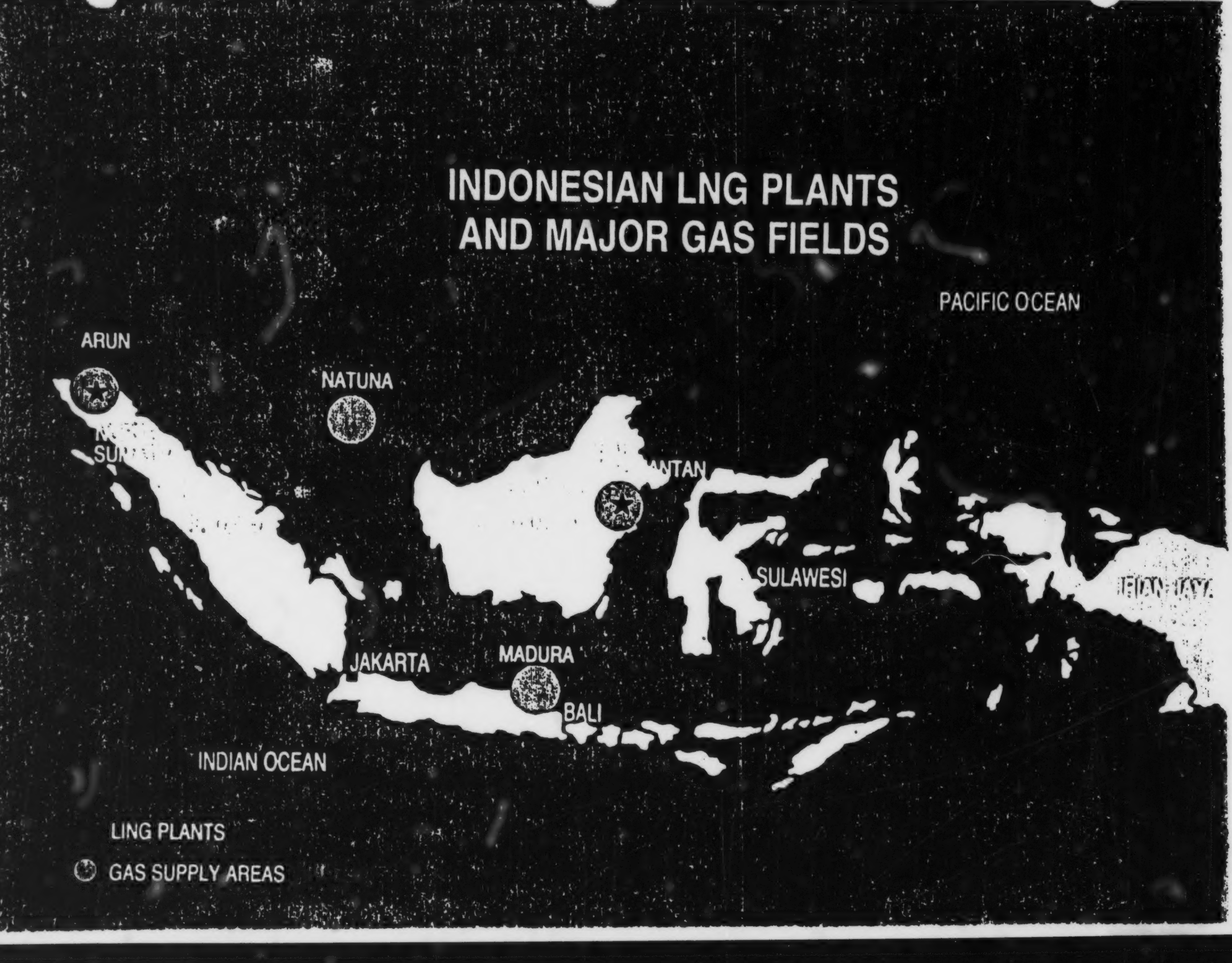
INDONESIA IN PERSPECTIVE

PACIFIC OCEAN
SULAWESI
JAKARTA
BALI
INDIAN OCEAN

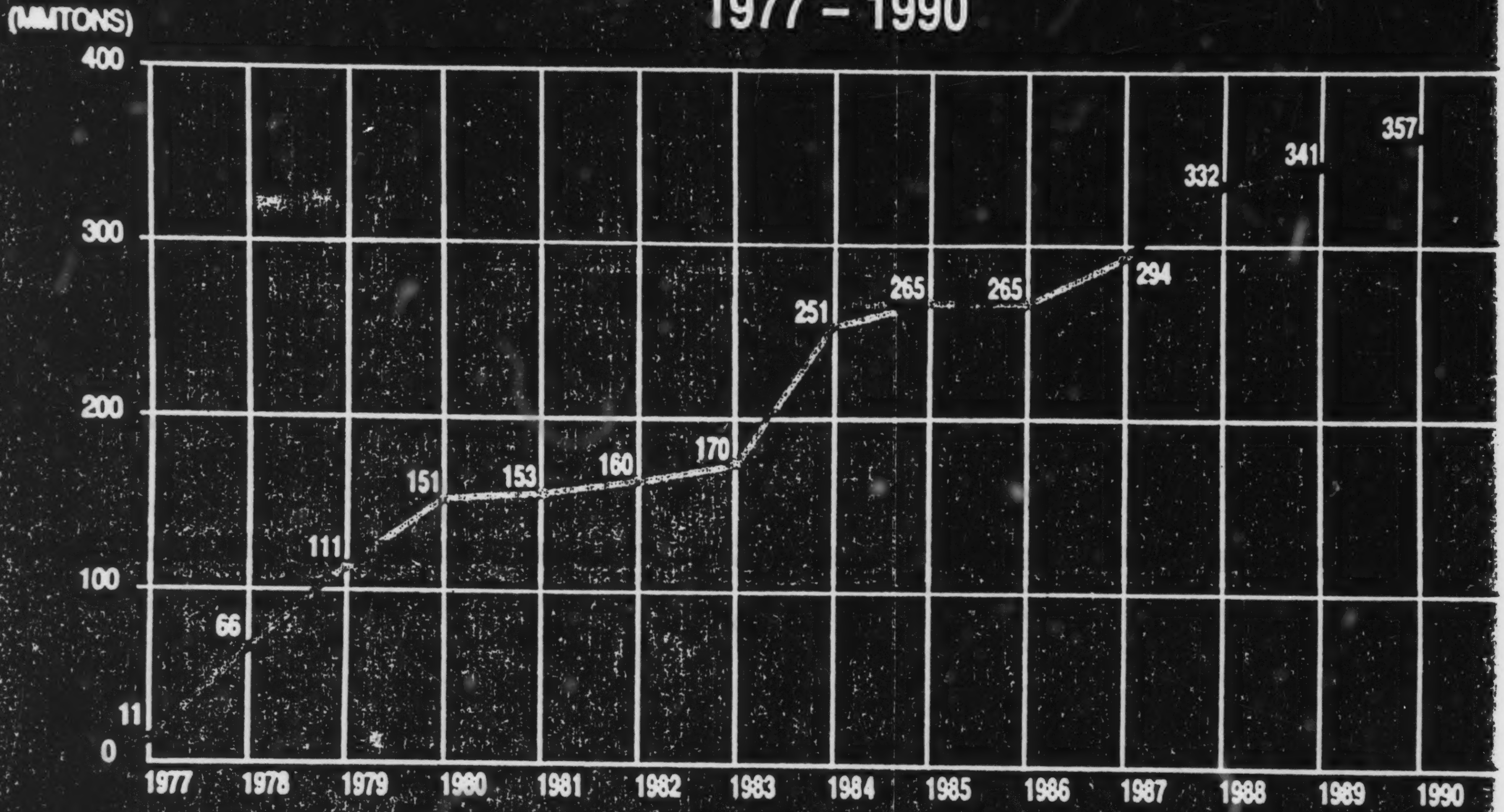
INDONESIA CRUDE OIL EXPORTS
1985 – 1989



INDONESIAN LNG PLANTS AND MAJOR GAS FIELDS


PACIFIC OCEAN
ARUN
NATUNA
ANTAN
SULAWESI
IRIAN JAYA
JAKARTA
MADURA
BALI
INDIAN OCEAN
LING PLANTS
GAS SUPPLY AREAS

INDONESIA LNG EXPORTS
1977 – 1990



NUMBER CARGOES/YEAR

* Thru 1989 – actuals

1990 – forecast

CONSUMER EXPECTATIONS FOR NEW LNG PROJECTS

- MORE FLEXIBILITY
- EASE TAKE OR PAY TERMS
- BROADER DEFINITION OF FORCE MAJEURE
- EVERGREEN OPTIONS ON UNCOMMITTED CAPACITY
- LOWER ESCALATION OF LNG PRICES
  IN RELATION TO OTHER FUELS
- LNG TO BE CHEAPER THAN EXISTING CIF PRICES
- SELLER TO ABSORB HIGHER TRANSPORTATION COSTS

PRODUCER EXPECTATIONS FOR NEW LNG PROJECTS

- LARGER BASELOAD QUANTITIES TO SUPPORT FINANCING COSTS AND UPSTREAM INVESTMENTS
- PRICE/BTU EQUIVALENCY TO OIL TO ENCOURAGE EXPLORATION FOR GAS
- EQUITABLE SHARING OF LNG CHAIN RISKS WITH CONSUMERS

NOTHING HAS CHANGED

- DEMAND REMAINS HIGH AND IS GROWING
- COSTS ARE INCREASING
- TRANSPORTATION REMAINS EXPENSIVE
- FINANCING STILL A KEY TO SUCCESSFUL PROJECTS
- PRODUCERS AND CONSUMERS STILL MUST COOPERATE IN FORGING AN LNG CHAIN

GAS MARKETING OPPORTUNITIES ARE CHANGING IN THE PACIFIC BASIN

- LNG NO LONGER ONLY "SHOW IN TOWN"
- OUTLETS FOR GAS NO LONGER LIMITED TO LNG SUPPLY/DEMAND FACTORS
- DOMESTIC GAS PROJECTS THROUGHOUT REGION OFFER INVESTMENT ALTERNATIVES TO LNG EXPORT PROJECTS
- PROSPECTIVE LNG BUYERS AND SELLERS MUST REMEMBER AND ACCEPT REALITIES OF THE LNG TRADE

NATURAL GAS IN THE PACIFIC BASIN HAS A GREAT POTENTIAL
FOR FUTURE GROWTH IN BOTH LNG PROJECTS
AS WELL AS IN DOMESTIC GAS PROJECTS, PROVIDED SUPPLIERS,
CUSTOMERS AND GOVERNMENT POLICY MAKERS
UNDERSTAND THE NEEDS, CHALLENGES AND OPPORTUNITIES
IN UTILIZING THIS OUTSTANDING ENERGY SOURCE

U.S. COAL SEAM GAS SUPPLY

Chris Allen
Manager, Gas Marketing
Meridian Oil
Houston, Texas

NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE

Calgary, Alberta
September 23-25, 1990

SLIDE #1 BROCHURE SLIDE - "COVER"

LADIES, GENTLEMEN AND DISTINGUISHED GUESTS, THANK YOU FOR THE OPPORTUNITY TO SPEAK TO YOU TODAY. LET ME TELL YOU WHAT IS GOING ON IN NORTHWEST NEW MEXICO AND SOUTHERN COLORADO AS A RESULT OF NEW AND INNOVATIVE TECHNOLOGY - DEVELOPMENT OF COAL SEAM GAS.

WHEN COAL SEAM GAS IS MENTIONED, SEVERAL QUESTIONS COME TO MIND:

- WHY THE SUDDEN INTEREST IN DEVELOPING COAL SEAM GAS RESERVES?
- HOW IS GAS PRODUCED FROM COAL?
- HOW BIG IS THE RESOURCE?
- WHAT IS BEING DONE TO DEVELOP COAL SEAM GAS?

I HOPE TO ANSWER THESE QUESTIONS AND SEVERAL MORE AS WE DISCUSS THIS TOPIC OF COAL SEAM GAS.

FIRST, HOWEVER, LET ME BRIEFLY TELL YOU ABOUT MERIDIAN OIL.

SLIDE #2 MERIDIAN OIL INC.

MERIDIAN, AS WE EXIST TODAY, IS A RESULT OF THE MERGERS OF FOUR COMPANIES - EL PASO EXPLORATION COMPANY, MILESTONE PETROLEUM, SOUTHLAND ROYALTY COMPANY AND EL PASO HYDROCARBONS COMPANY.

SLIDE #3 MAP OF UNITED STATES SHOWING REGIONS AND MAJOR BASINS "BROCHURE MAP - SLIDE"

MERIDIAN OIL IS ONE OF THE LARGEST INDEPENDENT OIL AND GAS COMPANIES IN THE UNITED STATES. OUR CORPORATE HEADQUARTERS ARE IN HOUSTON, TEXAS. WE HAVE FOUR REGIONAL OFFICES LOCATED IN DENVER, COLORADO; FARMINGTON, NEW MEXICO; MIDLAND, TEXAS; AND HOUSTON, TEXAS. WE ALSO HAVE ADMINISTRATIVE OFFICES IN FT. WORTH, TEXAS.

AS THE BAR CHART INDICATES ON THIS SLIDE, MERIDIAN HAS AN INTEREST IN 40,794 WELLS, OF WHICH WE OPERATE APPROXIMATELY 6,900.

AT YEAR-END 1990, MERIDIAN'S RESERVE POSITION OF 5.0 TRILLION CUBIC FEET OF GAS EQUIVALENT PLACES MERIDIAN eighth among natural gas producers based on domestic reserves. Also by year-end Meridian will have daily deliverability of 1.5 BCF per day. Our current reserve life is 20 years (compared to an overall industry average of 8 years). Meridian's current acreage position is as follows:

Developed acreage (gross):	4,675,000
Undeveloped acreage (gross):	3,663,000
Undeveloped mineral fee acreage:	7,000,000

We are definitely dedicated to the natural gas industry.

COAL SEAM GAS - A NEW, LONG-TERM GAS SUPPLY

Our industry's most recent development frontier is that of coal seam gas. We view coal seam gas as a new, long-term gas supply source for both producers and natural gas consumers. I will discuss the magnitude of this asset later, but first, let me tell you about the geological history and producing characteristics of coal seam gas.

Slide #4 SAN JUAN BASIN

The prominent coal seam deposits in New Mexico are in the San Juan Basin in the Northwest corner of the state. The basin is approximately 100 miles wide by 140 miles long and is the second largest producing field in the lower 48 states.

SLIDE #5 STRUCTURAL CROSS-SECTION

THE SAN JUAN BASIN IS A SAUCER SHAPED STRUCTURE WITH THE PRIMARY PRODUCTIVE FORMATIONS GENERALLY FOUND BETWEEN 2000 AND 8000 FEET. THE CONVENTIONAL SANDSTONE RESERVOIRS, THE PICTURED CLIFFS, MESAVERDE, AND DAKOTA, HAVE PRODUCED APPROXIMATELY 15 TRILLION CUBIC FEET OF GAS FROM OVER 18,000 WELLS DURING THE PAST SEVERAL DECADES.

THE FRUITLAND COAL FORMATION, SHOWN IN BLACK, LIES DIRECTLY ON TOP OF THE PICTURED CLIFFS SANDSTONE AND RANGES IN DEPTH FROM ABOUT 3000' IN THE CENTRAL BASIN TO SURFACE OUTCROPS ALONG THE WESTERN EDGES WHERE THE COAL IS COMMERCIALLY MINED.

SLIDE #6 CRETACEOUS SEAWAY

A LONG TIME AGO, ABOUT 75 MILLION YEARS, I AM TOLD, THE CRETACEOUS SEAWAY SPANNED THE CENTRAL UNITED STATES. THE SAN JUAN BASIN WAS ONE OF THE DEPOSITIONAL FEATURES FORMED DURING THIS TIME PERIOD. THESE FORMATIONS WERE DEPOSITED OVER A PERIOD OF APPROXIMATELY 25 MILLION YEARS ALONG THIS FLUCTUATING SEAWAY. THE FRUITLAND COAL WAS FORMED AS A RESULT OF ORGANIC MATERIAL DEPOSITED IN THE COAL SWAMPS AND MARSHES THAT FORMED BEHIND AND PARALLEL TO THE PICTURE CLIFFS SHORELINE.

SLIDE #7 CROSS-SECTIONAL VIEW OF ANCIENT DEPOSITIONAL ENVIRONMENT

A CROSS-SECTIONAL VIEW OF THIS DEPOSITIONAL ENVIRONMENT WOULD LOOK SOMETHING LIKE THIS. THE SAND DEPOSITS ARE DEPICTED HERE IN THE BRIGHTER YELLOW AND THE ORGANIC DEPOSITS WHICH ULTIMATELY FORMED THE COAL SHOWN IN BLUE/GREEN.

BOTH THE PICTURED CLIFFS AND FRUITLAND FORMATIONS ARE BELIEVED TO HAVE BEEN DEPOSITED DURING THE FINAL REGRESSION OF THIS ANCIENT SEAWAY. ONE IMPORTANT POINT TO NOTICE ON THIS CROSS-SECTION IS THAT THE COAL FORMATIONS ARE NOT ONE CONTINUOUS DEPOSIT. THERE ARE MULTIPLE COAL SEAMS CAUSED BY FLUCTUATIONS IN THE SEA LEVEL DURING DEPOSITION.

THE SEDIMENTS WERE BURIED AND APPROXIMATELY 50 MILLION YEARS AFTER DEPOSITION (25 MILLION YEARS AGO) WERE EXPOSED TO TEMPERATURE AND PRESSURE AS A RESULT OF VOLCANICS AND IGENEOUS INTRUSIONS (SAN JUAN AND LA PLATA MOUNTAINS).

SLIDE #8 NET THICKNESS MAP

WHAT RESULTED IS THE FORMATION OF THE FRUITLAND COAL SEAM AS WE KNOW IT TODAY. THIS SLIDE IS A NET THICKNESS ISOPACH OF THE FRUITLAND COAL PUBLISHED BY KELSO AND WICKS. I REALIZE THAT YOU CAN'T SEE THE NUMBERS ON THIS SLIDE, BUT THE COAL RANGES IN THICKNESS FROM LESS THAN TEN FEET ALONG THE SOUTHERN AND EASTERN EDGES OF THE BASIN TO GREATER THAN 80 FEET IN THE CENTRAL AND NORTHERN BASIN.

FOR MANY YEARS THE FRUITLAND COAL FORMATION WAS CONSIDERED A NUISANCE TO DRILL THROUGH BECAUSE OF THE NUMEROUS DRILLING PROBLEMS IT CREATED, ESPECIALLY IN THE NORTHERN PART OF THE BASIN WHERE THE COALS ARE OVERPRESSURED.

MUCH HAS BEEN LEARNED ABOUT THE COAL AND THE UNIQUE PROCESS BY WHICH GAS IS PRODUCED FROM COAL.

SLIDE #9 TYPICAL SANDSTONE PRODUCTION CURVES

IN A TYPICAL SANDSTONE RESERVOIR, GAS PRODUCTION STARTS OUT HIGH AND DECLINES. THIS PRODUCTION PROFILE OVER TIME GRAPHICALLY PRESENTS WHAT CAN BE EXPECTED FROM A TYPICAL SANDSTONE RESERVOIR. SANDSTONE GAS PRODUCTION, REPRESENTED BY THE RED CURVE, DECLINES OVER THE PRODUCTIVE LIFE OF THE WELL DUE TO DECLINING PRESSURES AND A DIMINISHING VOLUME OF HYDROCARBONS TRAPPED IN THE RESERVOIR PORE SPACES. WATER PRODUCTION, REPRESENTED BY THE BLUE CURVE, TYPICALLY STARTS OUT LOW AND INCREASES WITH TIME.

SLIDE #9 TYPICAL COAL SEAM PRODUCTION CURVES

IN CONTRAST, COAL SEAM WELLS TYPICALLY WILL START OUT WITH LOW GAS PRODUCTION AND HIGH WATER VOLUMES. OVER TIME, COAL SEAM GAS PRODUCTION REPRESENTED BY THE YELLOW CURVE, INCREASES AND WATER PRODUCTION DECREASES AS THE COALS ARE "DEWATERED". AT SOME POINT IN TIME, THE GAS PRODUCTION WILL

PEAK AND THE PRODUCTION SHOULD BEGIN DECLINING SIMILAR TO CONVENTIONAL RESERVOIRS. THIS UNIQUE PRODUCTION PROFILE IS A COMBINATION OF THE DEWATERING PROCESS AND THE MECHANISM BY WHICH GAS IS GENERATED.

SLIDE #10 MECHANISMS OF COAL PRODUCTION

COAL PRODUCES GAS BY A MECHANISM CALLED DESORPTION. DESORPTION IS THE REVERSE OF A PROCESS CALLED ADSORPTION. ADSORPTION IS THE PHYSICAL ADHESION OF A SINGLE LAYER OF GAS MOLECULES TO THE INTERNAL MICROPORE SURFACES OF THE COAL MATRIX.

AS PRESSURE IN THE RESERVOIR IS REDUCED, THIS GAS "BREAKS OUT" OR DESORBS FROM THE FACE OF THE COAL AS DEPICTED IN THE UPPER LEFT-HAND CORNER OF THIS SLIDE. THIS GAS MOVES THROUGH THE MICROPORE SPACES BY A PROCESS CALLED DIFFUSION.

THE GAS WORKS ITS WAY INTO NATURALLY OCCURRING FRACTURES CALLED CLEATS (UPPER RIGHT-HAND CORNER OF SLIDE). THESE CLEATS ARE FORMED DURING THE COALIFICATION PROCESS AND ARE TYPICALLY FILLED WITH WATER. PRODUCING THE WATER OUT OF THESE CLEATS IS WHAT IS REFERRED TO AS THE DEWATERING PROCESS.

THE CLEAT SYSTEM IS A SERIES OF PERPENDICULAR FRACTURES AS SHOWN IN THE LOWER RIGHT-HAND CORNER OF THE SLIDE. GAS AND WATER MOVE THROUGH THESE CLEATS TO LARGER FRACTURES AND TO THE WELLBORE.

SLIDE #11 ESTIMATED GAS IN PLACE

LET US NOW SPEND A FEW MINUTES ON THE MAGNITUDE OF THIS ASSET. INDEPENDENT RESERVE ESTIMATES OF THE GAS IN PLACE RANGE FROM 30 TCF TO AS HIGH AS 56 TCF. HOW MUCH OF THIS GAS RECOVERABLE? WE DON'T KNOW FOR SURE, BUT PUBLISHED ESTIMATES OF PROJECTED ULTIMATE RECOVERY RANGE FROM 10 TO 25 TCF.

DEVELOPMENT OF THE FRUITLAND COAL DATES BACK TO THE 1950'S. PHILLIPS PETROLEUM COMPLETED THE FIRST COAL WELL IN 1953. AMOCO DRILLED SEVERAL COAL WELLS IN THE CEDAR HILL FIELD IN THE MIN-1970'S. DESPITE THE EVIDENCE OF GAS IN THE FRUITLAND COALS, DEVELOPMENT WAS DETERRED DUE TO A COMBINATION OF LOW GAS PRODUCTION, LOW GAS PRICES AND HIGH OPERATING COSTS DUE TO HIGH WATER PRODUCTION.

A COMBINATION OF SEVERAL FACTORS HAVE CONTRIBUTED TO THE ACCELERATED DEVELOPMENT OF THE FRUITLAND COAL:

- FIRST OF ALL, SEVERAL YEARS OF PRODUCTION FROM EXISTING WELLS GAVE US A BETTER UNDERSTANDING OF COAL SEAM PRODUCTION TECHNOLOGY;

- ANOTHER FACTOR IS THE AVAILABILITY OF THE NON-CONVENTIONAL FUELS TAX CREDIT FOR COAL SEAM PRODUCTION, AND;

SLIDE #12 BROCHURE SLIDE COMPLETION RIG

- STILL ANOTHER IS THE ENCOURAGING RESULTS FROM THE PILOT PROGRAM WELLS DRILLED BY MERIDIAN. THE PILOT PROGRAM WELLS RESULTED IN HIGH RATE PRODUCERS DUE TO UNIQUE DRILLING AND COMPLETION METHODS. THIS PICTURE ILLUSTRATES THE MAGNITUDE OF GAS PRODUCED DURING TESTING OF ONE OF OUR COMPLETIONS.

I WOULD LIKE TO SPEND A FEW MINUTES NOW TALKING ABOUT THE DEVELOPMENT OF THIS ASSET.

SLIDE #13 TWENTY WELL PILOT PROGRAM

IN 1986 AND 1987, MERIDIAN DRILLED 20 WELLS TO TEST OUR FRUITLAND COAL ACREAGE. SHOWN HERE IN BLUE DOTS ARE THE LOCATIONS OF THE WELLS DRILLED AS A PART OF THIS PILOT PROGRAM. AS YOU CAN SEE, 19 OF THESE WELLS WERE DRILLED IN NEW MEXICO WITH THE HIGHEST CONCENTRATION BEING IN THE AREA AROUND NAVAJO LAKE.

SLIDE #14 BROCHURE SLIDE OF 30.6 UNIT

ALSO KNOWN AS THE SAN JUAN 30-6. WE SELECTED THESE WELLS TO TEST WHAT WE CONSIDERED TO BE THE HIGHEST POTENTIAL ACREAGE.

DUE TO SITE SELECTION AND INNOVATIVE TECHNOLOGY, THE RESULTS WERE EXTREMELY ENCOURAGING. NOT ONLY WAS THE OVERALL PROGRAM A SUCCESS, SEVERAL OF THESE WELLS SET NEW WORLD RECORDS FOR HIGHEST VOLUME PRODUCERS FROM COAL SEAM RESERVOIRS.

DAILY PRODUCTION - TWENTY WELL PILOT PROGRAM

DURING 1988, THESE WELLS WERE PRODUCING BETWEEN 50 AND 60 MMCF/D OR AN AVERAGE OF 2.5 TO 3.0 MMCF/D PER WELL (CURRENT PRODUCTION 2.889 MMCF/D PER WELL). DURING 1988, WE WERE PRODUCING APPROXIMATELY 5000 BWPD, WHICH ALSO HOLDS TRUE FOR TODAY.

CUMULATIVE PRODUCTION - TWENTY WELL PILOT PROGRAM

THROUGH MID-YEAR 1988, THESE 20 WELLS HAD PRODUCED 10.5 BCF AND TWO MILLION BARRELS OF WATER. THE CURRENT CUMULATIVE PRODUCTION THROUGH MID-YEAR 1990 FROM THESE WELLS IS APPROXIMATELY 48.7 BCF AND FOUR MILLION BARRELS OF WATER.

COAL SEAM PROJECT THROUGH MID YEAR 1990

THROUGH THE MID-YEAR 1990 MERIDIAN HAD DRILLED OR RECOMPLETED A TOTAL OF 556 COAL SEAM WELLS AT A COST OF

$170 MILLION. WE HAVE DEVELOPED IN EXCESS OF 600 BCF OF NET GAS RESERVES AND HAVE PROVED UP ALMOST AN ADDITIONAL 750 BCF. ON A GROSS RESERVE BASIS, THIS EQUATES TO A TOTAL OF 2.5 TCF OF PROVED GAS RESERVES. THE AVERAGE PRODUCTION FOR WELLS PRODUCING AT MID-YEAR 1990 WAS 1.1 MMCF/D.

MERIDIAN IS NOT THE ONLY COMPANY WHICH HAS BEEN DRILLING COAL SEAM WELLS. OTHER OPERATORS SUCH AS AMOCO, ARCO, NORTHWEST PIPELINE, BLACKWOOD & NICHOLS, MCHUGH, NASSAU RESOURCES AND OTHERS HAVE DRILLED MANY COAL SEAM WELLS OVER THE LAST FEW YEARS. ACTIVITY SHOULD REMAIN HIGH THROUGH 1990.

SLIDE #15 1988 & 1989 WELLS AND GATHERING SYSTEM

JUST TO GIVE YOU AN IDEA OF WHAT MERIDIAN HAS PLANNED, WE EXPECT TO DRILL, RECOMPLETE, OR PARTICIPATE IN OVER 400 WELLS DURING 1990 AND HAVE IMPLEMENTED THE INITIAL STAGES OF A MULTI-MILLION DOLLAR GATHERING AND TREATING SYSTEM TO HANDLE COAL SEAM GAS. THIS SLIDE SHOWS YOU THE COMBINATION OF OUR DRILLING PLANS AND OUR PROPOSED PLANT AND PIPELINE SYSTEM. WE ARE CURRENTLY GATHERING AND TREATING ABOUT 300 MMCF/D, WITH ADDITIONAL PLANT CAPACITY CURRENTLY UNDER CONSTRUCTION. IN THE VERY NEAR FUTURE, WE WILL BEGIN CONSTRUCTION OF ADDITIONAL GATHERING LINES.

TWO UNIQUE PROBLEMS ASSOCIATED WITH PRODUCING COAL SEAM GAS IS THE CO_2 PRESENT IN THE PRODUCTION STREAM AND THE HIGH WATER VOLUMES PRESENT, ESPECIALLY IN THE EARLY LIFE OF THE WELL. THE GAS STREAM FROM COAL SEAMS IS COMPRISED PRIMARILY OF METHANE AND CO_2. THE CO_2 MUST BE REMOVED BEFORE THIS GAS CAN BE SOLD. THE CO_2 CONCENTRATIONS RUN FROM AS LOW AS 1-2% TO AS HIGH AS 14%. MERIDIAN MADE THE DECISION EARLY IN OUR DEVELOPMENT PROGRAM THAT DUE TO THE MAGNITUDE OF THIS RESOURCE AND THE PROJECTED LONG LIFE OF THE RESERVES, THAT WE WOULD BUILD THE FACILITIES NECESSARY TO PURIFY THIS GAS AND GET IT TO THE MARKETPLACE.

SLIDE #16 VAL VERDE GATHERING SYSTEM PRESENT CAPACITY

VALVERDE GATHERING SYSTEM
PRESENT CAPACITY

PIPELINES:

- MA 150 MM/D
- MB 295 MM/D
- MD 180 MM/D (HART CANYON TO VAL VERDE)

625 MMCFD

COMPRESSOR STATIONS:

- GOBERNADOR 200 MM/D
- MANZANARES 86 MM/D
- HART CANYON 40 MM/D

325 MMCFD

PLANT:

- TRAINS 1, 2, 3, 4, 5 — 330 MM/D

SLIDE #17 VAL VERDE GATHERING SYSTEM IN PROGRESS

VALVERDE GATHERING SYSTEM
CAPACITY IN PROGRESS

PIPELINES:

- PUMP CANYON/MESA GAS GATHERING SYSTEMS - ANTICIPATED COMPLETION OCTOBER 15, 1990
- LATER MA-11 LOOP-ANTICIPATED COMPLETION SEPTEMBER 15, 1990

COMPRESSOR STATIONS:

- PUMP CANYON 110 MM/D ANTICIPATED STARTUP OCTOBER 1, 1990
- MANZANARES SECOND TWO-16'S 85 MM/D COMPRESSOR UNITS ORDERED (SHIP 11-1-90 AND 11-15-90) PERMIT RECEIPT EXPECTED MID OCTOBER TO MID DECEMBER, 1990

PLANT:

- TRAIN 6 100 MM/D ANTICIPATED STARTUP OCTOBER 15, 1990

CDP'S:

- SIMS MESA ANTICIPATED STARTUP AUGUST 15, 1990

SLIDE #18 VAL VERDE GATHERING SYSTEM ANTICIPATED STATUS

DECEMBER 31, 1990

VALVERDE GATHERING SYSTEM

ANTICIPATED STATUS - DECEMBER 31, 1990

PIPELINES:

- 100 MILES 16" AND 20" TRUNKLINES
- 295 TOTAL MILES OF TRUNKS, LATERALS, WELL TIES
- 625 MMCF/D TRUNKLINE CAPACITY

COMPRESSOR STATIONS:

- 4 OPERATING COMPRESSOR STATIONS
- 25,300 TOTAL HORSEPOWER INSTALLED
- 425 MMCF/D COMPRESSOR CAPACITY

PLANT:

- TRAINS 1-6 OPERATING
- 5,600 GPM TOTAL AMINE CIRCULATION
- 430 MMCF/D TREATING CAPACITY

$118.8MM CAPITAL INVESTED

THE OTHER MAJOR PROBLEM ASSOCIATED WITH COAL SEAM PRODUCTION IS THAT OF WATER DISPOSAL. MANY OPERATORS, INCLUDING MERIDIAN, ARE ADDRESSING THIS PROBLEM BY SPENDING THE REQUIRED CAPITAL TO BUILD WATER HANDLING FACILITIES AND DRILLING DISPOSAL WELLS.

CONCLUSION:

COAL SEAM GAS - A NEW LONG-TERM GAS SUPPLY

WE ARE HIGHLY OPTIMISTIC ABOUT THE FUTURE OF LONG TERM GAS SUPPLIES FROM THE FRUITLAND COAL. WE, ALONG WITH OTHER PRODUCERS, HAVE COMMITTED HUNDREDS OF MILLIONS OF DOLLARS TO DEVELOPING THIS RESOURCE.

COAL SEAM TECHNOLOGY IS A RAPIDLY DEVELOPING FIELD. WE ARE FORTUNATE THAT THE TECHNOLOGY EXISTS TODAY TO ECONOMICALLY DEVELOP THE COAL SEAM RESOURCES IN NEW MEXICO, AND OTHER REGIONS OF THE UNITED STATES.

I WANT TO THANK YOU FOR ALLOWING ME TO SPEAK TO YOU TODAY AND IF I CAN ANSWER ANY FURTHER QUESTIONS ON THIS SUBJECT, I WILL BE HAPPY TO AT THIS TIME.

ARKOMA BASIN SUPPLY POTENTIAL

Presented by

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USA

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OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

Abstract:

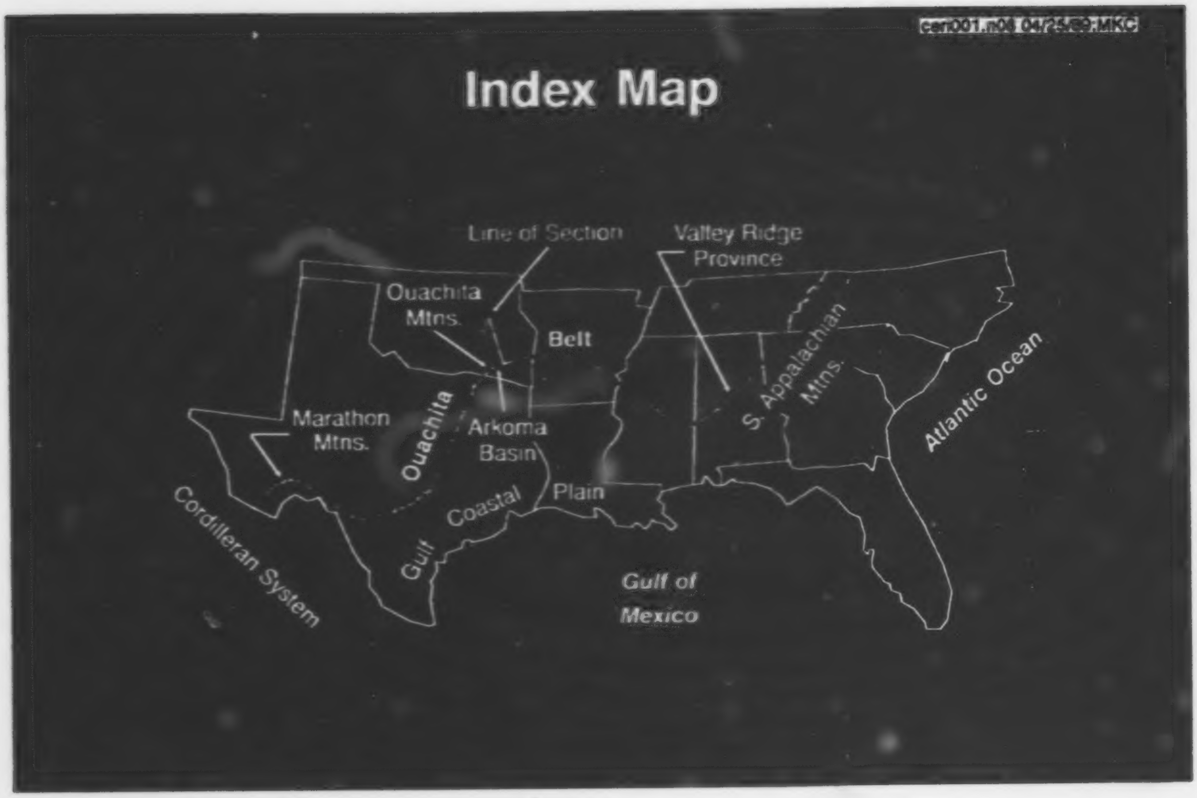
Amoco Production Company and several other operators have added approximately 0.9TCFG of proven reserves in the Arkoma Basin of Oklahoma since 1987. The reserves were added from two major plays along the Choctaw thrust fault. The first play discovered porous Pennsylvanian-age Spiro sands in stacked blind-imbricate thrusts beneath the Choctaw thrust plate, south of Wilburton Field. Secondary reservoirs were discovered in the Upper Pennsylvanian Atokan (Brazil equivalent) sands and in the Pennsylvanian Wapanucka limestones. IP's of these wells are 5-55MMCFGD, while per well reserves average 15BCFG. Amoco has led exploration in the play, operating or participating in more than 22 wells since 1987.

Arco's discovery of Deep Wilburton Field was the second major resource addition to the Arkoma Basin. Porous Cambro-Ordovician Arbuckle dolomites were found in a large block-faulted structure beneath the thrusted Spiro production in Wilburton Field. This discovery has proven recoverable reserves of 600-650BCFG. More than eight (8) additional wildcats have targeted the Arbuckle Group dolomites in the last eighteen months. Amoco currently has one deep well, the Devil's Backbone Unit #1, drilling towards a Paleozoic block-faulted structure east of Deep Wilburton field.

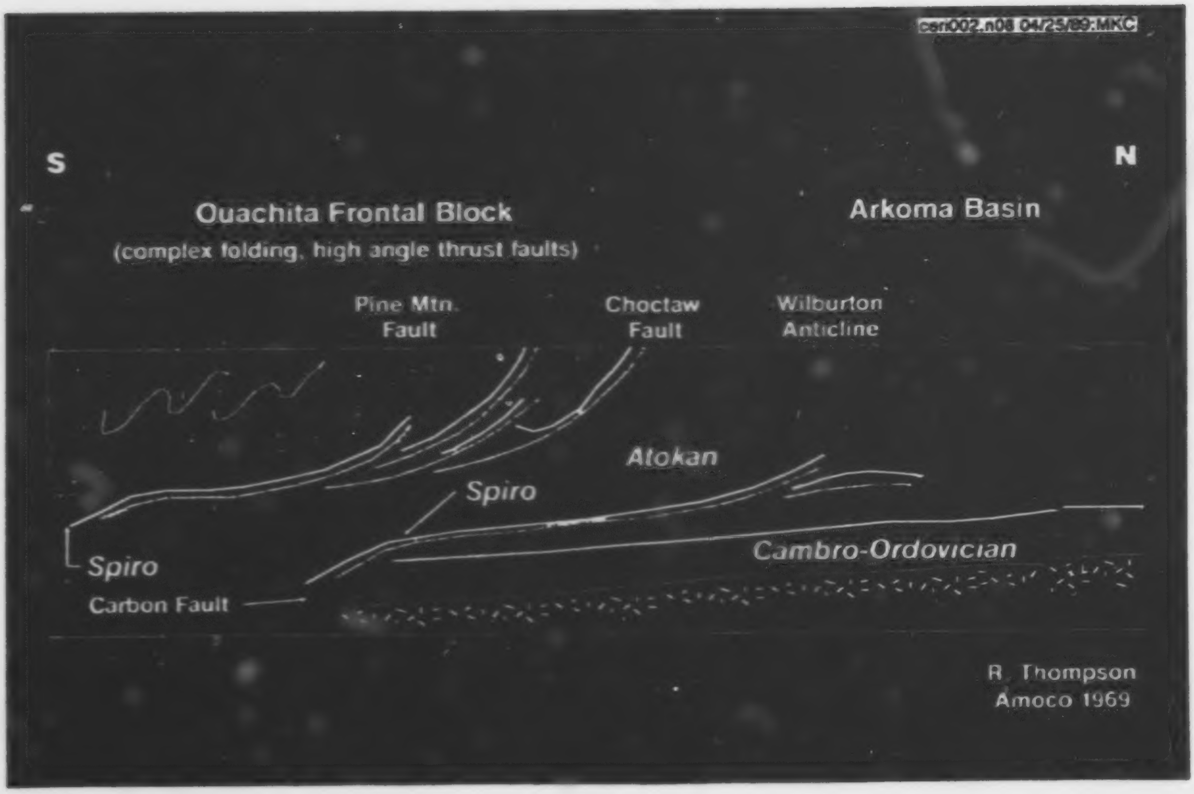
Amoco, Texaco and Exxon own one-third interest in the newly installed gas gathering system in the South Wilburton Field area. This system was installed within twelve months of the initial high-volume discoveries, permitting the operators to rapidly capitalize on exploration success. Today most new wells are tested directly to sales. Four interstate pipelines purchase gas from the Arkoma Basin, and a fifth (NGPL) is currently building a 200MMCFD pipeline into the area.

cen001.n08 04/25/89:MKC

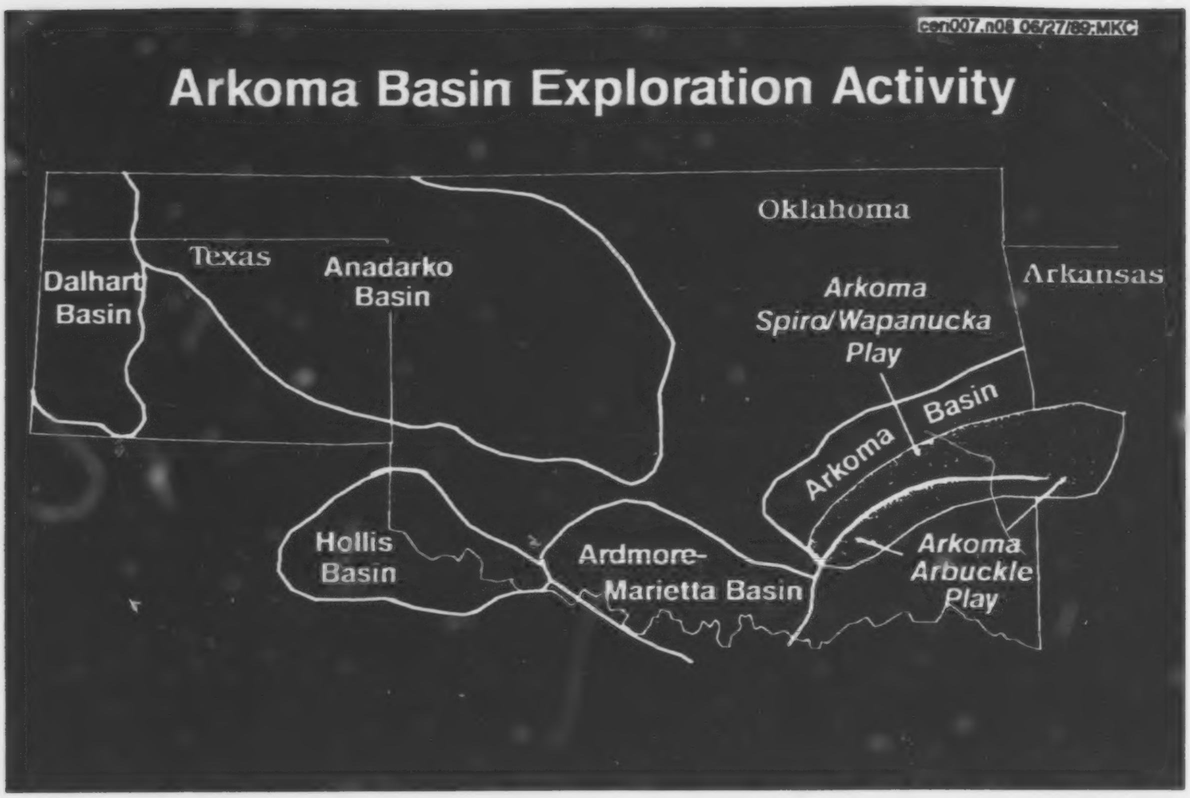
Index Map


Line of Section
Valley Ridge
Province
Ouachita
Mtns.
Belt
S. Appalachian
Mtns.
Atlantic Ocean
Marathon
Mtns.
Ouachita
Arkoma
Basin
Plain
Coastal
Gulf
Cordilleran System
Gulf of
Mexico

cen002.n08 04/25/89:MKC


S
N
Ouachita Frontal Block
(complex folding, high angle thrust faults)
Arkoma Basin
Pine Mtn.
Fault
Choctaw
Fault
Wilburton
Anticline
Atokan
Spiro
Spiro
Carbon Fault
Cambro-Ordovician

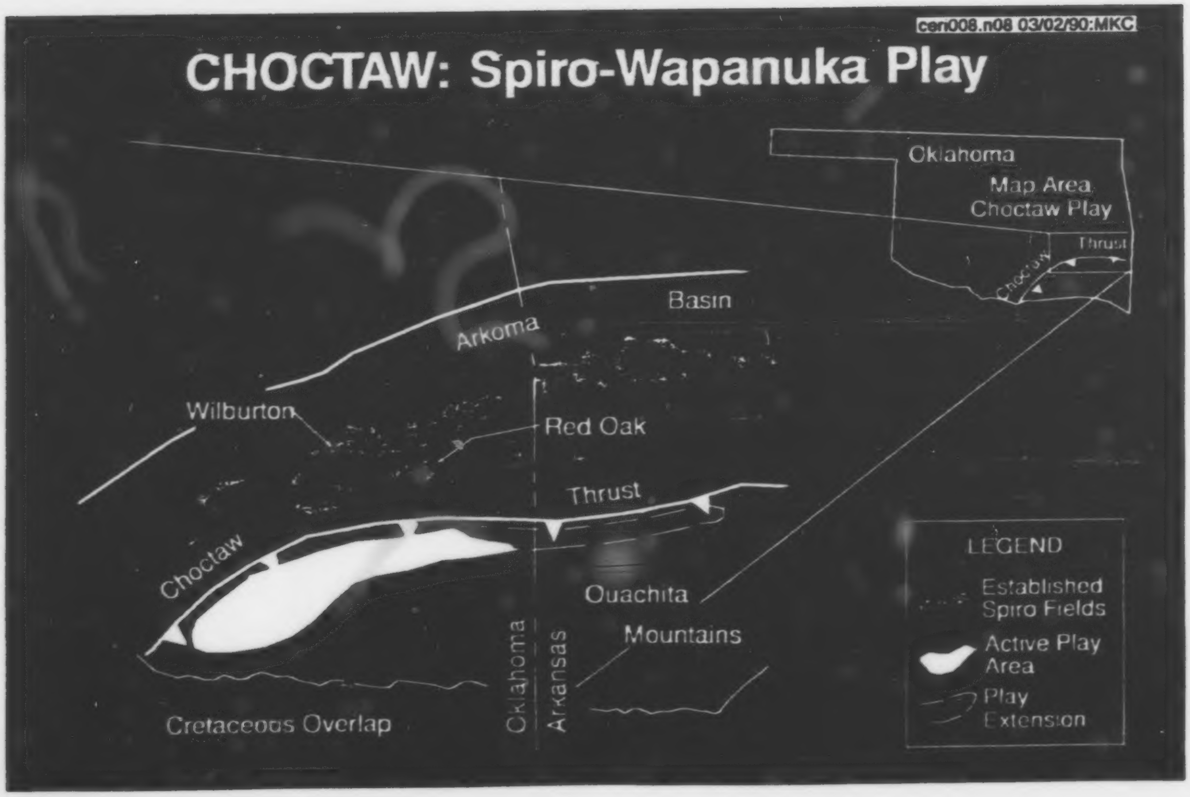
R. Thompson
Amoco 1969



cen007.n08 06/27/89:MKC

Arkoma Basin Exploration Activity

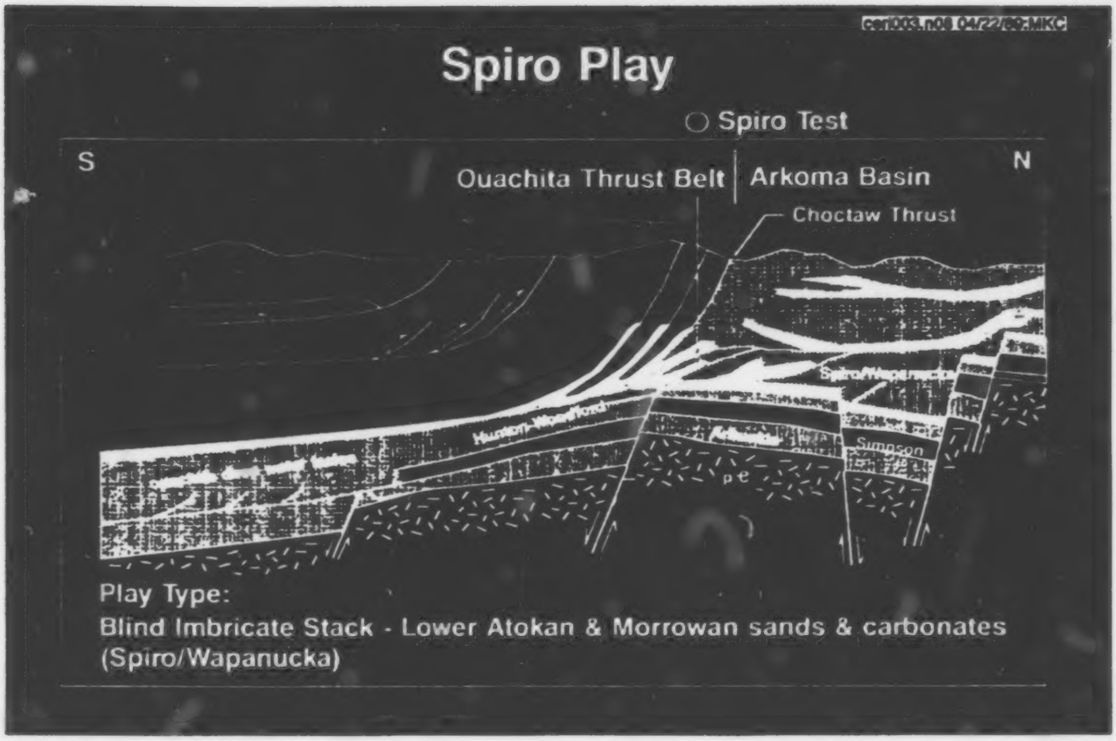
Oklahoma
Texas
Arkansas
Dalhart Basin
Anadarko Basin
Arkoma Spiro/Wapanucka Play
Arkoma Basin
Hollis Basin
Ardmore-Marietta Basin
Arkoma Arbuckle Play



cen008.n08 03/02/90:MKC

CHOCTAW: Spiro-Wapanuka Play

Oklahoma
Map Area Choctaw Play
Thrust
Choctaw
Arkoma
Basin
Wilburton
Red Oak
Thrust
Choctaw
Ouachita
Mountains
Oklahoma
Arkansas
Cretaceous Overlap
LEGEND
Established Spiro Fields
Active Play Area
Play Extension



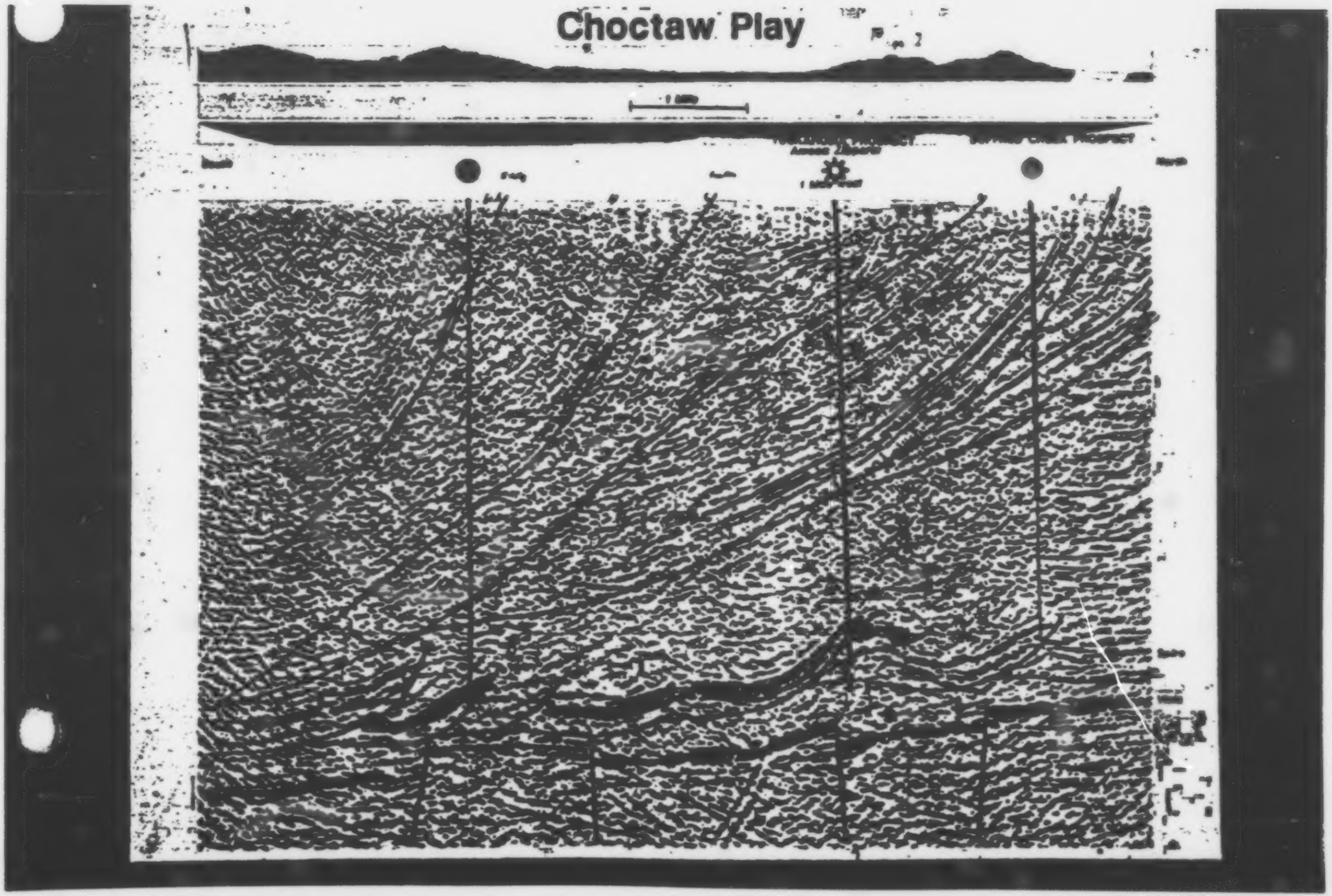
cen003.n08 04/22/89:MKC

Spiro Play

○ Spiro Test
S
N
Ouachita Thrust Belt
Arkoma Basin
Choctaw Thrust
Spiro/Wapanucka
Hunton-Woodford
Arbuckle
Simpson
pe

Play Type:

Blind Imbricate Stack - Lower Atokan & Morrowan sands & carbonates (Spiro/Wapanucka)



Choctaw Play

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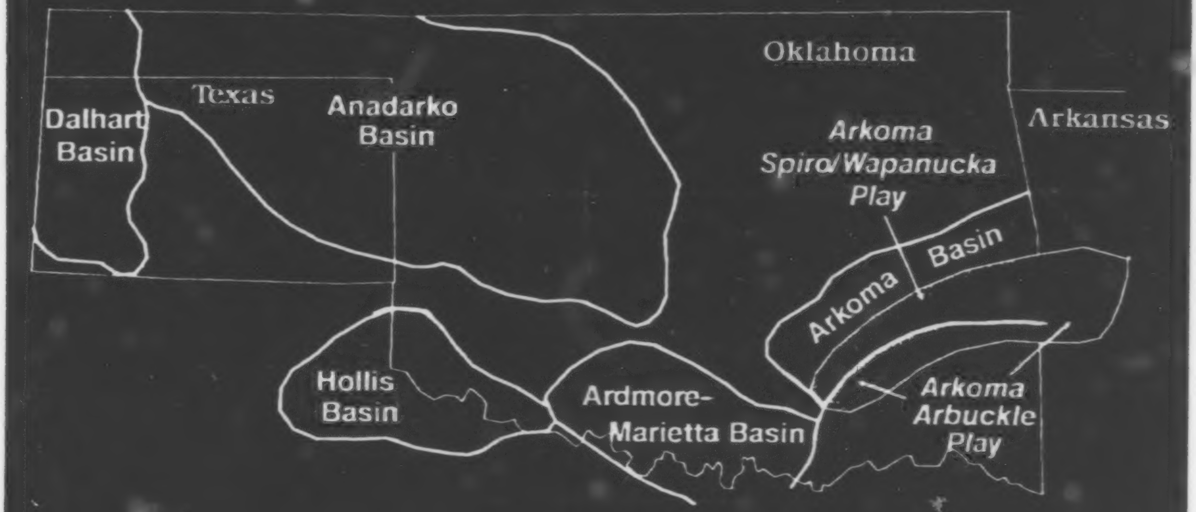
Arkoma Basin Exploration Activity


Oklahoma
Texas
Arkansas
Dalhart Basin
Anadarko Basin
Arkoma Spiro/Wapanucka Play
Arkoma Basin
Hollis Basin
Ardmore-Marietta Basin
Arkoma Arbuckle Play

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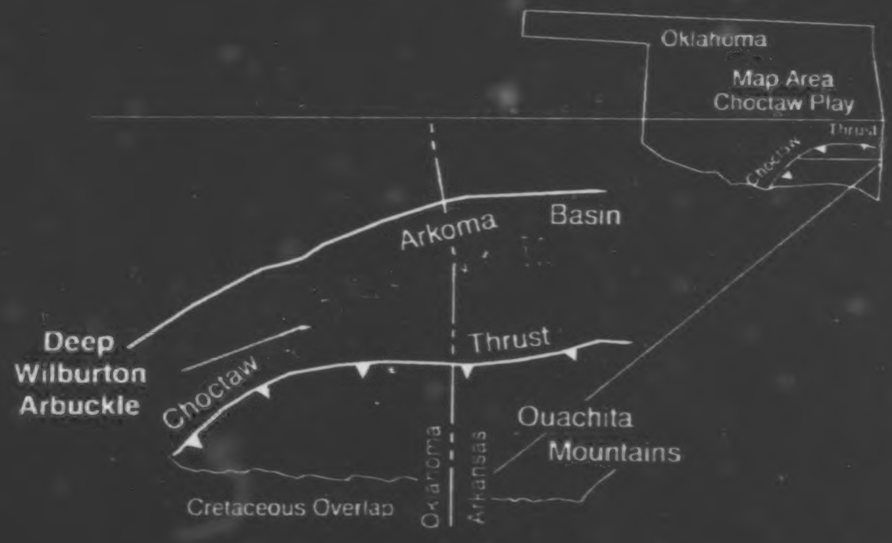
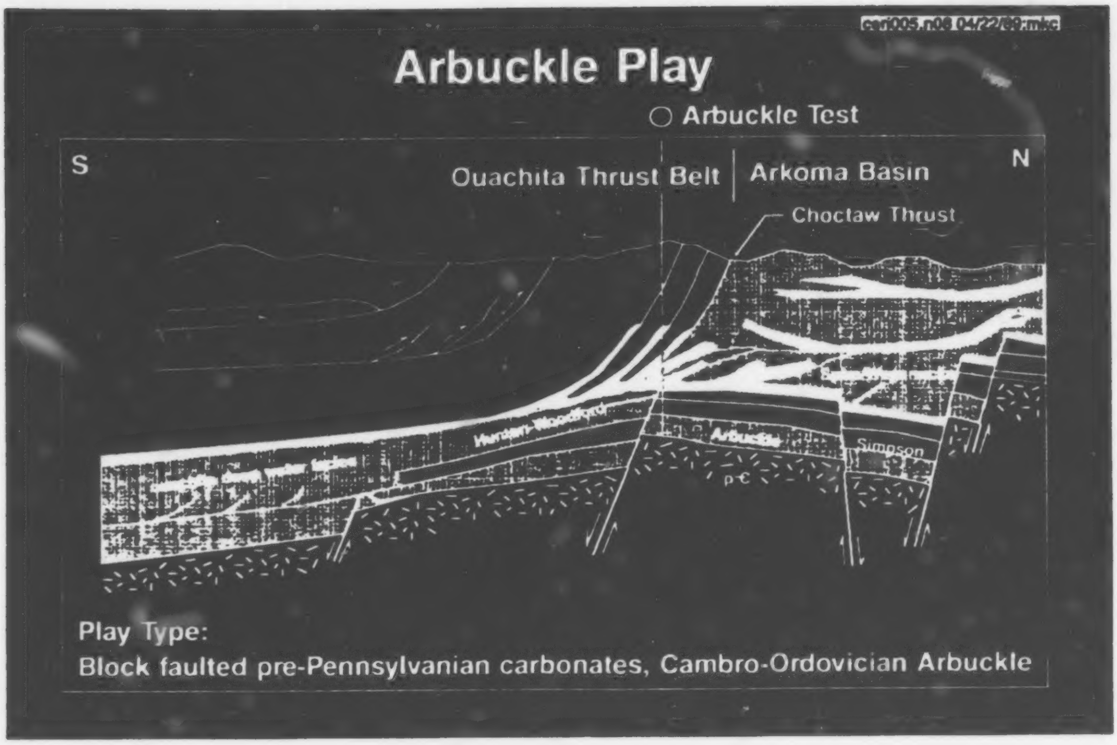
Arbuckle Play


Oklahoma
Map Area Choctaw Play
Choctaw
Thrust
Arkoma Basin
Deep Wilburton Arbuckle
Choctaw Thrust
Ouachita Mountains
Oklahoma
Arkansas
Cretaceous Overlap



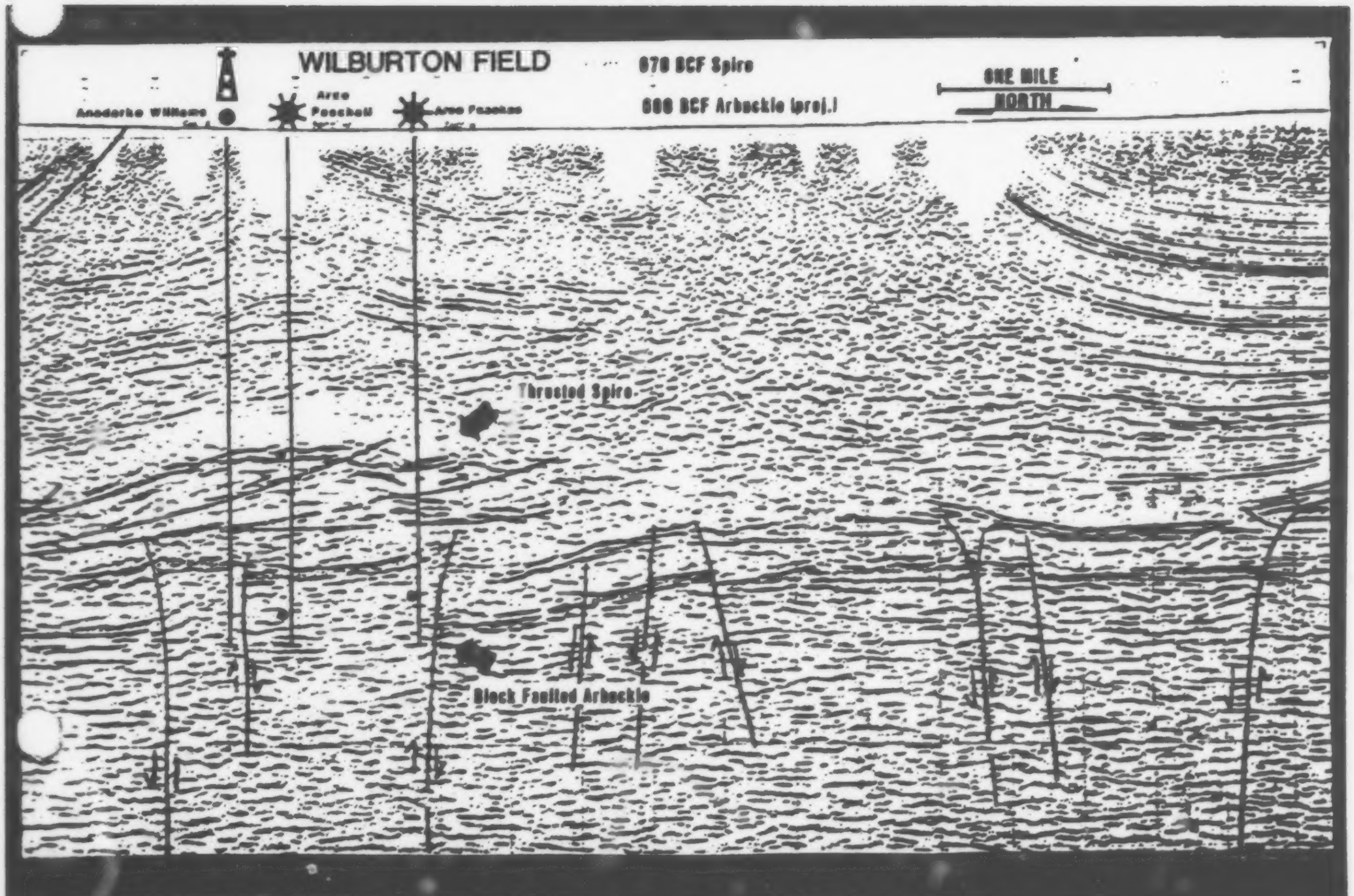
carl005.n08 04/22/89:mkc

Arbuckle Play

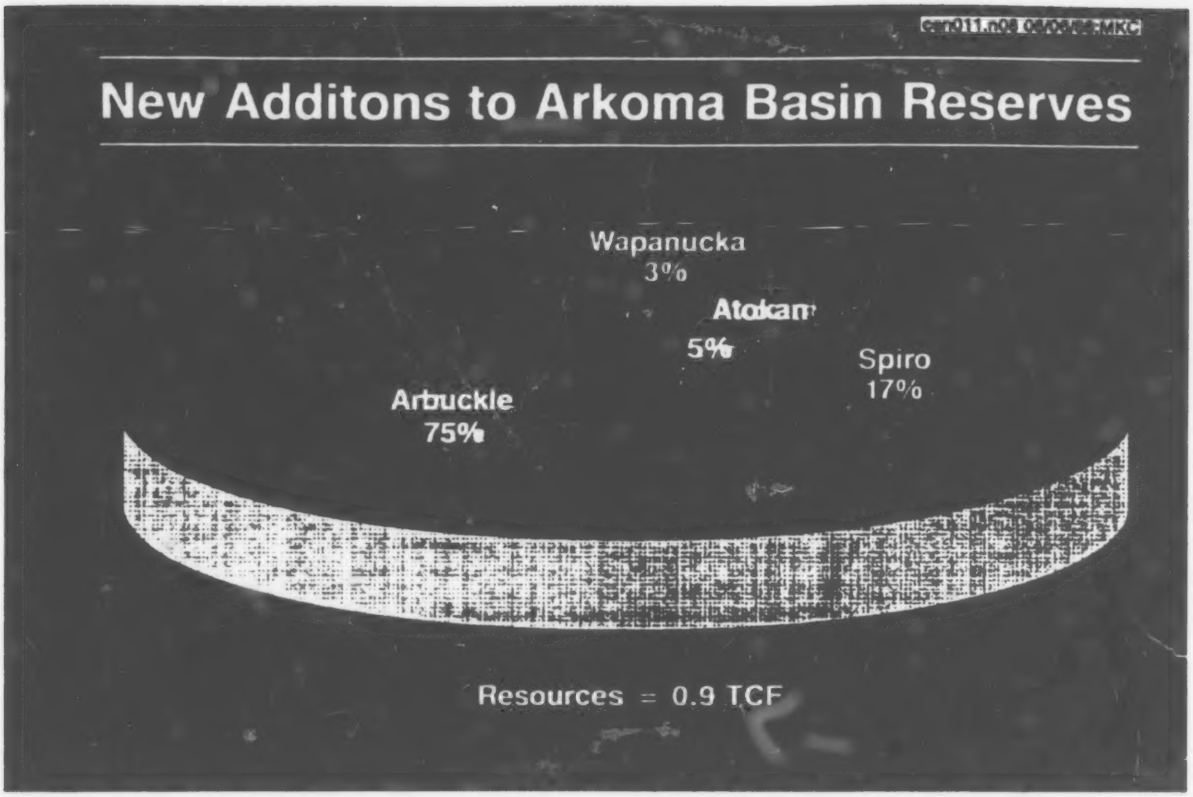
○ Arbuckle Test

S
Ouachita Thrust Belt
Arkoma Basin
N
Choctaw Thrust
Hunton-Woodford
Arbuckle
Simpson
pЄ

Play Type:
Block faulted pre-Pennsylvanian carbonates, Cambro-Ordovician Arbuckle



WILBURTON FIELD
670 BCF Spiro
600 BCF Arbuckle (proj.)
ONE MILE
NORTH
Anadarko Williams
Arco Paschall
Arco Paschall
Thrusted Spiro
Block Faulted Arbuckle



cen011.n08 06/06/88:MKC

New Additons to Arkoma Basin Reserves

Resources = 0.9 TCF

cen012.n08 06/06/88:MKC

Arkoma Basin - New Supply Production

Offshore Gulf of Mexico: Abstract

Presented by

J. E. Gotcher
Director, Supply Development
Tenneco Gas
Houston, Texas
USA

NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

The Gulf of Mexico, for several decades now, has been the mainstay of U.S. offshore drilling, attracting the bulk of major U.S. oil companies' exploration and development budgets with over 40 years of production. To some, the Gulf may be considered a mature region, but technology is changing the complexion of the industry. Advances in 3-D seismic, horizontal drilling, deepwater drilling, and overall improvements in drilling technology are not only changing the way we explore for and develop oil and gas, but are providing access to reserves previously discounted as uneconomic or impossible to exploit. The changing face of the Gulf is allowing independents to move into the shallow waters of the Gulf while majors continue to push out into the unexplored areas which offer potential for world class reserves. In addition, the overall outlook for the U.S. natural gas industry has recently improved, helping to influence activity in the Gulf. The Gulf has historically been a dominant force in the search for oil and gas. And, all factors point to the Gulf of Mexico's continued prominence in U.S. gas production for many years to come.

REMARKS BY IAN C. MACNABB

CERI INTERNATIONAL CONFERENCE, CALGARY

SEPTEMBER 25, 1990

SLIDE GOOD AFTERNOON LADIES AND GENTLEMEN. IT IS A PLEASURE FOR ME TO BE WITH YOU TODAY TO PRESENT A CANADIAN GAS ASSOCIATION FORECAST OF DOMESTIC NATURAL GAS DEMAND TO THE YEAR 2000.

MY COMMENTS WILL COVER THREE BASIC AREAS; A LOOK AT THE DOMESTIC SALES BREAKDOWN IN THE PAST CALENDAR YEAR; CGA'S FORECAST OF DOMESTIC DEMAND TO THE YEAR 2000; AND A BRIEF OVERVIEW OF SOME NEW AND PROMISING MARKET AREAS.

SLIDE TODAY, NATURAL GAS SUPPLIES 3.8 MILLION CUSTOMERS IN CANADA AND ACCOUNTS FOR 28.5% OF TOTAL PRIMARY ENERGY DEMAND. ONLY OIL, WHICH IS BUOYED BY A HIGHLY DEPENDENT AUTOMOTIVE MARKET, OUTRANKS GAS IN MARKET SHARE. IF WE WERE TO BACK OUT THE TRANSPORTATION SECTOR AND THE ATLANTIC PROVINCES (WHERE NATURAL GAS IS NOT YET DISTRIBUTED), THE GAS SHARE WOULD JUMP DRAMATICALLY.

SLIDE AT THE OUTSET I WOULD LIKE TO EMPHASIZE THE IMPORTANCE OF BOTH THE DOMESTIC AND THE EXPORT MARKET FOR THE CANADIAN GAS INDUSTRY. IN 1989 DOMESTIC GAS SALES GREW BY 7.1%, EXPORTS INCREASED BY 5.6%, BOTH COMING OFF A STRONG PREVIOUS YEAR. DOMESTIC GAS SALES CURRENTLY ACCOUNT FOR 60% OF TOTAL SALES VOLUMES.

SLIDE 1989 GROWTH IN THE DOMESTIC MARKET WAS ACCOUNTED FOR UNIFORMLY, IN PERCENTAGE TERMS, BY ALL THREE MARKET SEGMENTS - INDUSTRIAL, COMMERCIAL AND RESIDENTIAL. FIGURES FOR THE FIRST HALF OF 1990 HOWEVER, SHOW SLIGHT NEGATIVE GROWTH REFLECTING WARMER WEATHER AND A WEAKENING ECONOMY.

LET'S TAKE A QUICK LOOK AT THE POSITION OF NATURAL GAS IN EACH OF THESE THREE MARKET SEGMENTS AS ANALYZED IN CGA'S FORECAST.

SLIDE THE INDUSTRIAL SECTOR ACCOUNTS FOR 56% OF DOMESTIC NATURAL GAS SALES, AND ABOUT 40% OF DOMESTIC SALES REVENUES. NATURAL GAS HAS PERFORMED VERY WELL IN THIS HUGE, HOTLY COMPETITIVE MARKET, PARTICULARLY WITH PRICE DEREGULATION. SINCE 1986 THE MARKET SHARE FOR GAS HAS INCREASED BY FOUR PERCENTAGE POINTS TO 41%.

SLIDE THE COMMERCIAL SECTOR, WHICH ACCOUNTS FOR 23% OF DOMESTIC SALES, HAS BEEN A SLIGHTLY MORE DIFFICULT MARKET FOR NATURAL GAS DUE LARGELY TO THE LOWER INSTALLATION COSTS OF OUR COMPETITION. HOWEVER GAS CONTINUES TO MAINTAIN MARKET DOMINANCE WITH A 40% SHARE.

SLIDE NATURAL GAS IS CLEARLY THE FUEL OF CHOICE FOR RESIDENTIAL SPACE HEATING. ITS CLEAN BURNING CHARACTERISTICS AND STABLE PRICING HAVE HELPED IT WIN 44% OF THE RESIDENTIAL MARKET. THE SEGMENT NOW ACCOUNTS FOR 21% OF TOTAL GAS SALES. IT'S GETTING OVER 80% OF THE NEW HOUSING MARKET IN ITS FRANCHISED AREAS.

NOW BEFORE GETTING INTO OUR DEMAND FORECAST TO THE YEAR 2000 I WOULD LIKE TO SAY A FEW WORDS ABOUT THE FORECAST'S ORGIN.

THE FORECAST REPRESENTS THE COMBINED PERSPECTIVE OF CGA MEMBERS FROM THE GAS RESOURCE, DISTRIBUTION AND TRANSMISSION SECTORS, THE HEART OF CANADA'S NATURAL GAS INDUSTRY. THESE COMPANIES BEST UNDERSTAND THE REGIONAL AND SECTORIAL GROWTH PATTERNS AND POTENTIAL, AND IT IS THE ASSEMBLY OF THIS INFORMATION ON A CONSENSUS BASIS WHICH IS THE STRENGTH OF THE FORECAST.

I WOULD LIKE TO EMPHASIZE THE CONSERVATIVE NATURE OF THE FORECAST. THE UNDERLYING ASSUMPTIONS USED IN ITS DEVELOPMENT DO NOT SPECULATE ON THE POTENTIAL FOR NATURAL GAS DEMAND GROWTH FROM THE INTRODUCTION OF NEW GAS TECHNOLOGIES. NOR DO THEY ESTIMATE THE INCREASING DEMAND FOR GAS WHICH WILL RESULT FROM ENVIRONMENTAL INITIATIVES.

OUR FIGURES INCLUDE ALL NATURAL GAS MADE AVAILABLE AFTER LEAVING THE PROCESSING PLANTS. ALSO INCLUDED IS ANY HIGH ETHANE-CONTENT GAS SOLD TO CUSTOMERS UPSTREAM OF THE REPROCESSING PLANTS, ANY SHRINKAGE OR FUEL USED AT THESE PLANTS, AND GAS USED AS COMPRESSOR FUEL IN TRANSPORTATION.

SECTORIALLY NATURAL GAS VEHICLES AND LARGE MULTI-UNIT APARTMENT BUILDINGS ARE GROUPED IN THE COMMERCIAL MARKET, AND USAGE OF GAS IN POWER PLANTS IS INCLUDED IN THE INDUSTRIAL SECTOR. NATURAL GAS USED IN ALBERTA IN THE PETROLEUM SECTOR, (FOR ENHANCED OIL RECOVERY, CRUDE BITUMEN EXTRACTION AND SYNTHETIC PRODUCTION) IS DEFINED AS "PRODUCER'S OWN-USE" UNDER THE INDUSTRIAL SECTOR.

ALL FORECASTED NUMBERS HAVE BEEN WEATHER-NORMALIZED. ANNUAL GROWTH RATES HAVE BEEN CALCULATED ON A COMPOUNDED AVERAGE BASIS, AND REPRESENT GROWTH FROM 1989 TO 2000.

IN DEVELOPING THE FORECAST THE FOLLOWING ASSUMPTIONS WERE MADE:

SLIDE - THE EFFECT OF ENERGY CONSERVATION ON SALES WILL DECLINE FROM 1% TO .5% BY THE YEAR 2000.

ARGUMENTS ABOUT THE CONSERVATION VARIABLE COULD BE MADE FROM BOTH SIDES, HOWEVER WE HAVE MADE THE ASSUMPTION THAT THE EFFECTS OF CONSERVATION WILL DECLINE OVER TIME.

THE CONSENSUS VIEW IS THAT WE WILL SEE:

- A 2.8% AVERAGE ANNUAL REAL GROWTH RATE IN GDP.
- AN AVERAGE ANNUAL INCREASE IN THE CONSUMER PRICE INDEX OF 4.6%.
- HOUSING STARTS DECLINE TO 150,000 BY THE YEAR 2000 FROM 190,000 IN 1989.

OUR PRICING ASSUMPTION IS THAT CURRENTLY DEPRESSED GAS PRICES WILL INCREASE AT TWICE THE RATE OF OIL, BRINGING THE PRICE OF THE FUELS MUCH CLOSER BY 2000. ELECTRICITY, WITH NO REAL INCREASE PROJECTED, WILL PRESENT AN EVER GREATER COMPETITIVE THREAT.

- AND SO FOR GAS WE ASSUME AN AVERAGE ANNUAL REAL PRICE INCREASE OF 2%; FOR OIL 1% AND FOR ELECTRICITY AN INCREASE CONSISTENT WITH INFLATION, OR ZERO REAL GROWTH.

SLIDE LOOKING AHEAD TO THE CLOSE OF THE CENTURY CGA ANTICIPATES AVERAGE ANNUAL INCREASES IN DOMESTIC NATURAL GAS CONSUMPTION OF 2.1%. THIS TRANSLATES TO A VOLUME FIGURE OF 2.9 TCF, OR A 26% INCREASE OVER 1989 VOLUMES.

SLIDE WE EXPECT THE LARGEST PERCENTAGE INCREASE WILL BE IN QUEBEC. QUEBEC IS THE GAS INDUSTRY'S NEWEST REGIONAL MARKET AND ITS NEAR TERM GAS MARKETING STRATEGIES ARE FOCUSSING ON ITS INDUSTRIAL SECTOR, WHICH WILL SHOW THE GREATEST EXPANSION.

SLIDE INDEED IT IS THE INDUSTRIAL SECTOR WHICH WILL LEAD NATIONAL GAS SALES INCREASES TO THE TURN OF THE CENTURY. TODAY THE SECTOR ACCOUNTS FOR 55.9% OF TOTAL GAS VOLUME; BY 2000 IT WILL REPRESENT 57.2%. BOTH RESIDENTIAL AND COMMERCIAL SHARES OF TOTAL VOLUME WILL DECLINE SLIGHTLY.

SLIDE B.C. TURNING TO THE FORECAST ON A REGION-BY-REGION BASIS WE WILL START WITH THE WEST COAST. AVERAGE ANNUAL GAS VOLUME GROWTH IN BRITISH COLUMBIA IS ESTIMATED AT 1.2% OVER THE NEXT TEN YEARS.

THE RESIDENTIAL SECTOR, COMING OUT OF A FLAT 1988 AND 1989, WILL SEE SOME GROWTH IN THE EARLY PART OF THE FORECAST DUE TO VIBRANT NEW HOUSING CONSTRUCTION ACTIVITY. THEREAFTER GROWTH WILL BE A LITTLE MORE SUBDUED.

GROWTH IN THE COMMERCIAL SECTOR WILL BE STEADIER, AND WILL PICK UP MOMENTUM AS THE DECADE CLOSES.

THE 1989 REVITALIZATION OF THE BURRARD THERMAL GENERATING PLANT IS IN LARGE PART THE CAUSE OF A SIZEABLE JUMP IN INDUSTRIAL GAS LOAD EARLY IN THE PERIOD. THE VANCOUVER ISLAND PIPELINE WILL ENSURE INCREASED VOLUMES, - PARTICULARLY IN THE INDUSTRIAL SECTOR, TO THE END OF THE FORECAST PERIOD.

SLIDE
ALTA

THE NATURAL GAS MARKET IS AT ITS MOST MATURE IN THE PROVINCE OF ALBERTA. THIS, COUPLED WITH A LESS THAN DYNAMIC ECONOMY IN RECENT YEARS, PRODUCES A RELATIVELY FLAT PERFORMANCE IN THE RESIDENTIAL SECTOR. IN THIS SECTOR AVERAGE ANNUAL GROWTH RATES ARE FORECAST AT JUST 0.6%.

THE COMMERCIAL SECTOR WILL PERFORM A LITTLE BETTER WITH A 1.6% ANNUAL GROWTH RATE.

IN THE INDUSTRIAL SECTOR, LARGE ENERGY-RELATED PROJECTS ARE BEHIND AN EXPECTED 2.9% AVERAGE ANNUAL INCREASE IN VOLUMES. THE OSLO PROJECT WILL ADD TO PRODUCER OWN USE OF GAS; AND THE LLOYDMINISTER UPGRADER, WITH ITS HUGE FEEDSTOCK REQUIREMENTS, WILL BOOST OVERALL INDUSTRIAL SALES. AS WELL, INCREASES IN BOTH EXPORT AND DOMESTIC DEMAND WILL TRANSLATE TO EXPANDED GAS USE IN ALBERTA PROCESSING PLANTS AND TRANSMISSION LINES.

SLIDE SASK ALTHOUGH WORKING FROM A MUCH SMALLER BASE THAN IN NEIGHBOURING ALBERTA, SUBSTANTIAL ANNUAL GAS VOLUME INCREASES OF 4.3% ARE FORECAST IN SASKATCHEWAN'S INDUSTRIAL MARKET. THIS WILL BE ACCOUNTED FOR BY THE BORDER-STRADDLING LLOYDMINISTER HEAVY OIL UPGRADER; AND A NEW FERTILIZER PLANT AMONG OTHER PROJECTS.

RESIDENTIAL AND COMMERCIAL MARKETS WILL GROW AT A VERY MUCH SLOWER RATE, EVEN DIPPING TO ZERO OR NEGATIVE VALUES IN THE SECOND HALF OF THE FORECAST PERIOD, AS THE LONG TERM EFFECTS OF A POOR AGRICULTURAL ECONOMY CAUSE NET OUT-MIGRATION.

SLIDE MAN. MANITOBA IS CONSPICUOUS IN THAT IT IS THE ONLY REGION TO RECORD AN INDUSTRIAL SECTOR WITH LOWER GAS VOLUMES THAN THE RESIDENTIAL AND CONSUMER MARKETS. THIS IS A REFLECTION OF THE RELATIVELY SMALL NUMBER OF PRIMARY INDUSTRIES IN THE

PROVINCE. VOLUME GROWTH PATTERN FOR THE FORECAST PERIOD IS CORRESPONDINGLY SLOW, MOVING IN A PARALLEL LINE WITH THAT OF THE RESIDENTIAL SECTOR.

THE RESIDENTIAL SECTOR IS THE GREATEST IN VOLUME TERMS BUT, IN KEEPING WITH HISTORIC TRENDS, IS EXPECTED TO SHOW ONLY SOLID, PREDICTABLE GROWTH TO 2000.

GROWTH IN THE COMMERCIAL SECTOR WILL BE SIMILAR, ALTHOUGH IT IS EXPECTED TO DO SLIGHTLY BETTER THAN THE OTHER TWO MARKET SECTORS LATER IN THE FORECAST.

SLIDE ONT. IN ONTARIO WE ARE EXPECTING CONTINUED STRONG GROWTH IN THE RESIDENTIAL SECTOR THROUGHOUT THE DECADE AS THE PROVINCE'S MIXED ECONOMY DRAWS POPULATION FROM HOME AND ABROAD. THIS WILL HAVE A POSITIVE IMPACT ON THE SERVICE SECTOR INCREASING COMMERCIAL SALES, THOUGH NOT AT THE SAME RATE AS THE RESIDENTIAL MARKET.

THE INDUSTRIAL MARKET, AFTER SOME SLIGHT GYRATIONS IN GROWTH DURING THE FIRST FEW YEARS, WILL LEVEL OFF TO AVERAGE ANNUAL GAS VOLUME GROWTH LEVELS OF 1%.

SLIDE QUE. AS MENTIONED EARLIER QUEBEC'S INDUSTRIAL SECTOR WILL SEE DRAMATIC INCREASES IN GAS DEMAND - IN THE ORDER OF 4.4%

ANNUALLY - TO THE YEAR 2000. THIS DOWNPLAYS THE POTENTIAL FOR SUBSTANTIAL INDUSTRIAL LOAD INCREMENTS FROM LARGE COGENERATION PROJECTS, BUT DOES TAKE INTO ACCOUNT SUCH PROJECTS AS THE HUGE SOLIGAZ PETROCHEMICAL PROGRAM.

THE EMPHASIS ON NURTURING AND DEVELOPING THE INDUSTRIAL MARKET WILL, IN PART, AFFECT THE RESIDENTIAL MARKET. GROWTH IN THIS SECTOR WILL REMAIN FLAT.

THE COMMERCIAL SECTOR WILL GROW AT A RELATIVELY HEALTHY AVERAGE ANNUAL RATE OF 3.4%.

SLIDE LOOKING AT THE REGIONS OF THE COUNTRY EMPIRICALLY WE SEE THAT, WHILE QUEBEC IS FORECAST TO SHOW STRONG GROWTH, ITS SHARE OF NATIONAL GAS CONSUMPTION WILL STILL BE LESS THAN 10% BY 2000. ALBERTA, HISTORICALLY THE LARGEST GAS CONSUMER, WILL INCREASE ITS SHARE FURTHER TO 38.4%. SASKATCHEWAN WILL ALSO IMPROVE ITS STANDING; AND THE SHARE OF THE REMAINING PROVINCES WILL DECLINE LED BY ONTARIO WITH A 1.7 PERCENTAGE POINT DROP.

AS I HAVE EXPLAINED, THE VERY CONSERVATIVE ASSUMPTIONS USED IN THIS FORECAST IGNORE THE IMMENSE OPPORTUNITIES OPEN TO NATURAL GAS AS A RESULT OF INCREASING CONCERNS ABOUT ENVIRONMENTAL DEGRADATION, PARTICULARLY ATMOSPHERIC

POLLUTION. THEY ALSO IGNORE THE DEVELOPMENT AND COMMERCIALIZATION OF NEW, HIGHLY EFFICIENT AND ENVIRONMENTALLY PREFERABLE GAS UTILIZATION EQUIPMENT AND TECHNOLOGIES.

WHAT I WOULD LIKE TO DO NOW IS TO EMPHASIZE THE GREAT UPSIDE POTENTIAL FOR NATURAL GAS BEYOND THE 3 TCF WHICH WE HAVE FORECAST FOR 2000.

SLIDE AS YOU ARE AWARE ALL GOVERNMENTS HAVE BEGUN THE PROCESS OF ENVIRONMENTAL POLICY DEVELOPMENT, USING THE CONSULTATIVE PROCESS. THE FEDERAL GOVERNMENTS LONG AWAITED GREEN PLAN WILL BE RELEASED THIS FALL.

ENVIRONMENTAL ISSUES WILL REMAIN VERY HIGH ON THE POLITICAL AGENDA THROUGH THE DECADE AND BEYOND. CGA'S OWN NATIONAL CONSUMER POLLS SUPPORT THIS CONCLUSION AND INDICATE THAT THE PUBLIC HAS A VERY POSITIVE ATTITUDE TOWARDS NATURAL GAS.

SLIDE RELATIVE TO COAL, OIL OR NUCLEAR GENERATED ELECTRICITY, NATURAL GAS STANDS OUT AS THE MOST ACCEPTABLE ENERGY FORM FROM AN ENVIRONMENTAL STANDPOINT.

SLIDE AS AN INDUSTRY WE ARE STANDING ON FAIRLY SOLID GROUND. ON A SCALE OF 1 TO 10 THE NATURAL GAS INDUSTRY RANKS SECOND TO

AGRICULTURE AS ONE WHICH IS DOING SOMETHING TO HELP THE ENVIRONMENT, CONSIDERABLY AHEAD OF THE NUCLEAR AND OIL INDUSTRIES.

SLIDE THIS IS CONSISTENT WITH A GENERAL INDUSTRY IMAGE QUESTION WE HAVE PUT TO RESPONDENTS OVER THE PAST FOUR SURVEYS. PUBLIC PERCEPTION OF THE GAS INDUSTRY AS A GOOD CORPORATE CITIZEN HAS IMPROVED STEADILY FROM A SCORE OF 54% IN 1985 TO 66% TODAY. SUBSEQUENT QUESTIONS IN THE SURVEY PROVE THAT THE MAIN REASON FOR THIS POSITIVE FEELING IS THE BELIEF THAT GAS ITSELF IS ENVIRONMENTALLY PREFERABLE.

WE'RE QUITE PLEASED WITH THE RESULTS OF THIS SURVEY, HOWEVER WE RECOGNIZE THAT THERE IS STILL A BIG JOB TO BE DONE TO COMPLETE THE EDUCATION PROCESS IF NATURAL GAS IS TO BENEFIT FROM THIS ENVIRONMENTAL OPPORTUNITY.

ACCORDINGLY, EARLIER THIS YEAR, WE LAUNCHED A FULLY INTEGRATED COMMUNICATION PROGRAM TO SENSITIZE GOVERNMENTS, MEDIA AND THE PUBLIC TO THE CLEAN BURNING ATTRIBUTES OF NATURAL GAS. OUR MESSAGE ACKNOWLEDGES THAT NATURAL GAS IS A FOSSIL FUEL AND, AS SUCH, IS PART OF THE PROBLEM. HOWEVER IT ALSO EXPLAINS THAT NATURAL GAS IS BY FAR THE LEAST CARBONACEOUS OF THE FOSSIL FUELS, AND THAT IT CAN THEREFORE BE A MUCH LARGER PART OF THE SOLUTION, AND A VERY ACCEPTABLE "BRIDGING" ENERGY FORM UNTIL A BETTER SOLUTION IS FOUND.

LET ME MENTION THREE AREAS WHERE THIS IS IMPORTANT. THE EMERGING MARKET FOR NATURAL GAS AS A TRANSPORTATION FUEL IS SHOWING PROMISE AND THE INTEREST HAS INCREASED MARKEDLY SINCE THE IRAQ STANDOFF. CERTAINLY CLEAN BURNING NATURAL GAS AS AN ALTERNATIVE TO DIESEL FUEL AND GASOLINE HOLDS STRONG APPEAL FOR THE CONSUMER, AS EVIDENCED IN OUR NATIONAL OPINION SURVEY.

SLIDE OUR LAST STUDY IN 1989 SHOWED THAT 22% OF CANADIANS ARE VERY OR SOMEWHAT WILLING TO CONVERT THEIR VEHICLES TO NATURAL GAS AT A COST OF $1,000 - $2,000. THIS IS UP FROM ONLY 12% IN OUR PREVIOUS SURVEY. AND THE MAIN REASON GIVEN NOW IS ENVIRONMENTAL. IT USED TO BE THE LOW COST BENEFIT.

SLIDE THE PROMISE OF BEING ABLE TO FILL THE FAMILY CAR UP IN THE DRIVEWAY FROM THE HOUSEHOLD GAS SYSTEM BOOSTS WILLINGNESS TO CONVERT TO 50%.

THE ATTRACTION OF NATURAL GAS FOR VEHICLES IS BEING ENHANCED SUBSTANTIALLY BY THE STRINGENT EMISSION STANDARDS NOW BEING PUT IN PLACE IN THE U.S. AND CANADA.

JUST RECENTLY YOU MAY HAVE READ THAT IN LOS ANGELES, UNITED PARCEL SERVICE CONVERTED 2700 OF ITS VEHICLES TO NATURAL GAS.

SLIDE IN TORONTO, MISSISSAUGA, AND HAMILTON PUBLIC TRANSIT BUSES ARE NOW BEING CONVERTED TO NATURAL GAS AND ANOTHER 50 ARE ON

SLIDE ORDER. WITH THE INTRODUCTION OF THE RESIDENTIAL FUELLING APPLIANCE, PRIVATE MOTORISTS IN CANADA CAN ACTUALLY NOW REFILL IN THE DRIVEWAY FROM THEIR OWN GAS SYSTEM.

ALREADY THERE ARE SOME 25,000 NATURAL GAS VEHICLES IN CANADA AND, WITH NATURAL GAS ENGINES TO REPLACE DIESEL, AUTO MANUFACTURERS PLANNING DEDICATED VEHICLES, SOPHICTICATED GASEOUS FUEL MANAGEMENT SYSTEMS FOR PRIVATE AUTOMOBILES, THIS NUMBER IS GOING TO INCREASE CONSIDERABLY OVER THE NEXT FEW YEARS WITH POSITIVE EFFECTS ON NATURAL GAS DEMAND.

PROJECTIONS TO 1993 CONSERVATIVELY DOUBLE THE TOTAL NUMBER OF NATURAL GAS POWERED VEHICLES TO 50,000 UNITS WITH AN AVERAGE ANNUAL GAS CONSUMPTION RATE OF 4.7 BCF.

THE CANADIAN GAS ASSOCIATION IS ALSO DEDICATED TO WINNING A LARGER SHARE OF INDUSTRIAL ENERGY MARKETS BY DEVELOPING AND BRINGING TO MARKET EVEN MORE ADVANCED GAS UTILIZATION TECHNOLOGIES. OUR INDUSTRY IS CONNECTED TO THE WORLDWIDE GAS TECHNOLOGY NETWORK WITH A MANDATE TO TRANSFER AND ADAPT INTERNATIONAL INNOVATIONS IN GAS TECHNOLOGY TO THE CANADIAN DOMESTIC MARKET.

SLIDE TO DATE NEW INDUSTRIAL GAS UTILIZATION TECHNOLOGIES HAVE PRODUCED SEVERAL HIGHLY EFFICIENT, NON-POLLUTING, HIGH TEMPERATURE COMBUSTION SYSTEMS, FORGE FURNACES AND SMELTERS.

SLIDE A NEW GAS-FIRED PROCESS, WHICH RENDERS SCRAP IRON BY USING CERAMIC SPHERES IN PLACE OF COKE AS THE SMELTING MEDIUM, IS BOTH NON-POLLUTING AND OFFERS VERY HIGH LEVELS OF QUALITY CONTROL.

THESE AND OTHER MARKET DEVELOPMENT INITIATIVES ARE GOING TO ENHANCE THE INDUSTRIAL MARKET FORECAST FIGURES WE DISCUSSED EARLIER.

SLIDE ALREADY GAS-FIRED COGENERATION SYSTEMS ARE MAKING AN IMPACT IN CANADA. THEIR POTENTIAL FOR INCREASING LOAD, AS EVIDENCED IN THE U.S., IS CONSIDERABLE.

SLIDE AS YOU PROBABLY KNOW, COGENERATION PROCESSES ARE HIGHLY EFFICIENT. GAS-FIRED TURBINES PRODUCE ELECTRICITY, WHILE AT THE SAME TIME USE THE EXHAUST GASES FROM THE TURBINE TO PRODUCE HEAT.

TODAY APPROXIMATELY 80 BCF OF GAS IS ACCOUNTED FOR BY GAS-FIRED COGENERATION PROJECTS - LARGELY IN ONTARIO, AND OUR CONSERVATIVE FORECAST INCLUDES THESE PRESENTLY ECONOMICALLY VIABLE PROJECTS.

HOWEVER A MORE OPTIMISTIC VIEW WOULD BOOST THIS CONSIDERABLY. ASSUMING

- NO SUBSTANTIAL IMPROVEMENTS IN COGENERATION TECHNOLOGY;
- NO CHANGE IN CURRENT INDUSTRY PAYBACK CRITERIA FOR LARGE CAPITAL PROJECTS;
- NO SIGNIFICANT CHANGE IN THE BUY BACK RATE POLICY OF ELECTRIC UTILITIES, AND
- NO CHANGE IN GAS/ELECTRICITY PRICE RATIO.

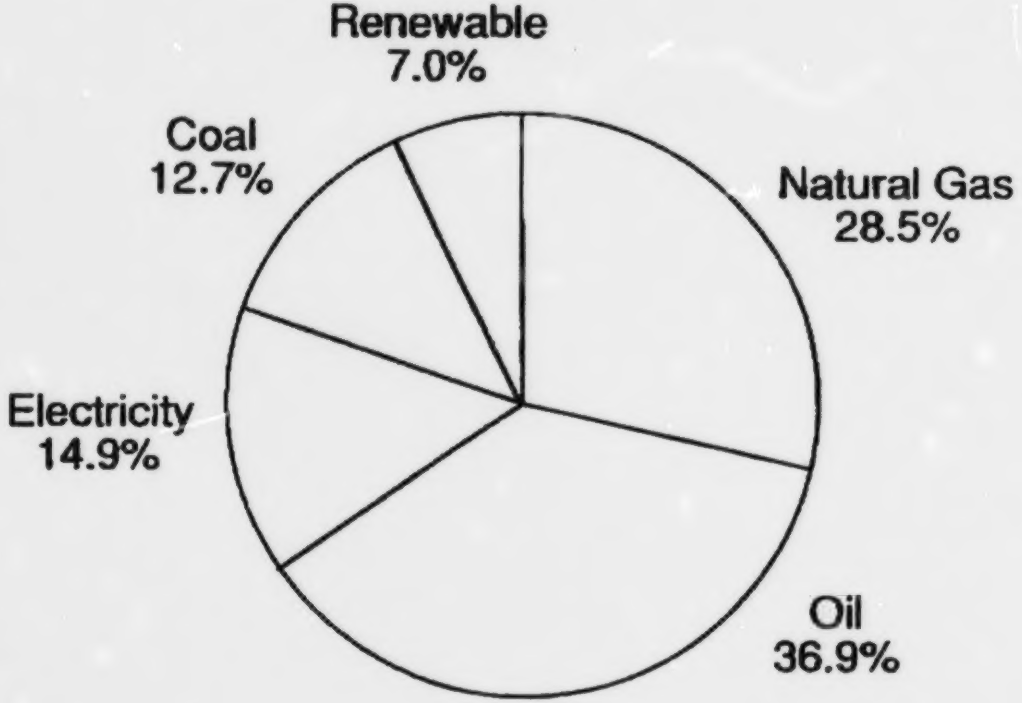
SLIDE WE BELIEVE THE ECONOMIC POTENTIAL OF COGENERATION INDUCED GAS VOLUME BY THE YEAR 2000 WILL BE 250 BCF. FURTHER, IF, CONTRARY TO OUR FORECAST, ELECTRICITY PRICES WERE TO INCREASE AT A FASTER RATE THAN GAS OVER THE NEXT DECADE THIS FIGURE COULD INCREASE TO 350 BCF.

SLIDE AND SO, TO SUM UP, THE DOMESTIC GAS MARKET IS ROBUST, WITH A VERY SIGNIFICANT POTENTIAL FOR NEW MARKET GROWTH, NEW DEVELOPMENTS IN TECHNOLOGY WILL BE BUOYED BY AN INCREASING RECOGNITION OF NATURAL GAS AS THE ENVIRONMENTALLY PREFERABLE FUEL. THESE DEVELOPMENTS WILL LIKELY BOOST OUR FORECASTED VOLUMES CONSIDERABLY.

FOR THOSE OF YOU WHO ARE INTERESTED, WE WILL BE PRODUCING AN UPDATED DOMESTIC DEMAND FORECAST BY THE END OF THE YEAR, AND WILL BE PLEASED TO ADD YOU TO OUR MAILING LIST.

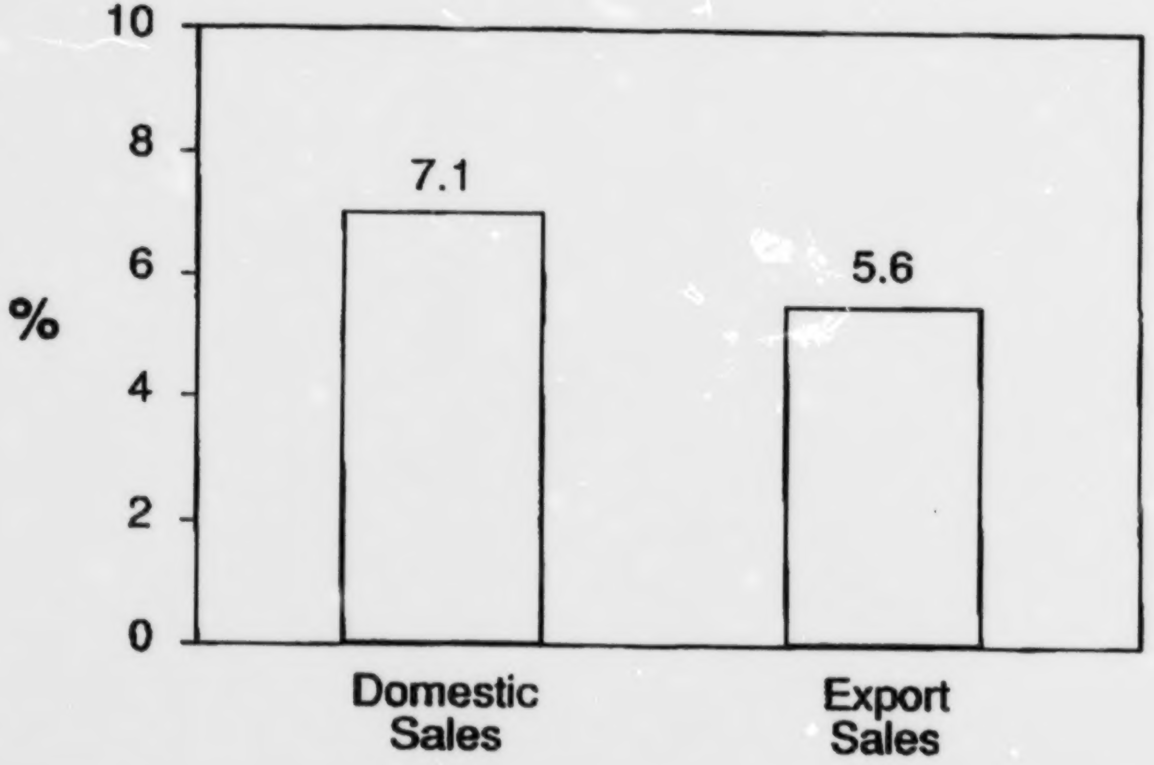
THANK YOU FOR YOUR ATTENTION.

Total Primary Energy Demand
(Shares %)



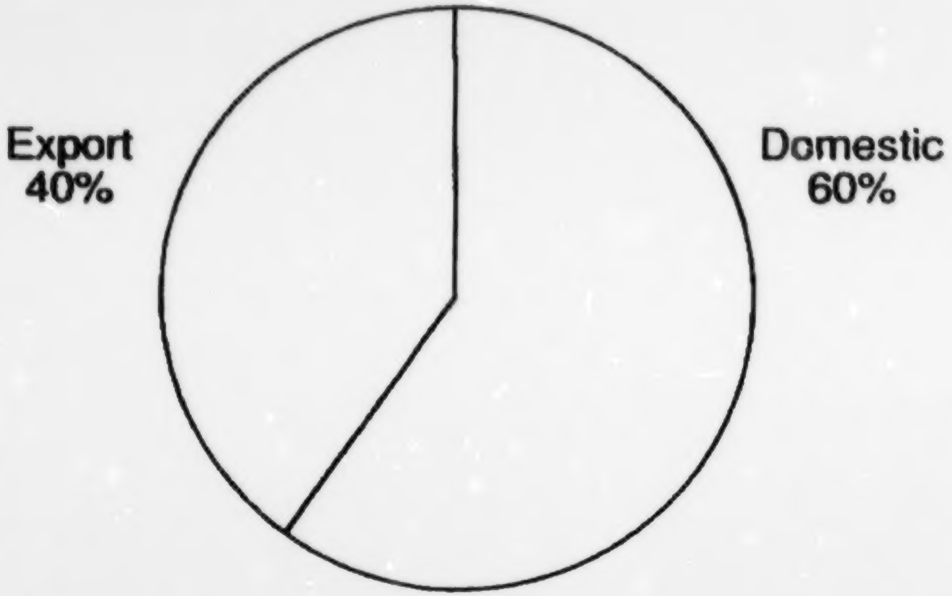
Export/Domestic Gas Markets

1989 Growth Rates



Export/Domestic Gas Markets

1989 Shares



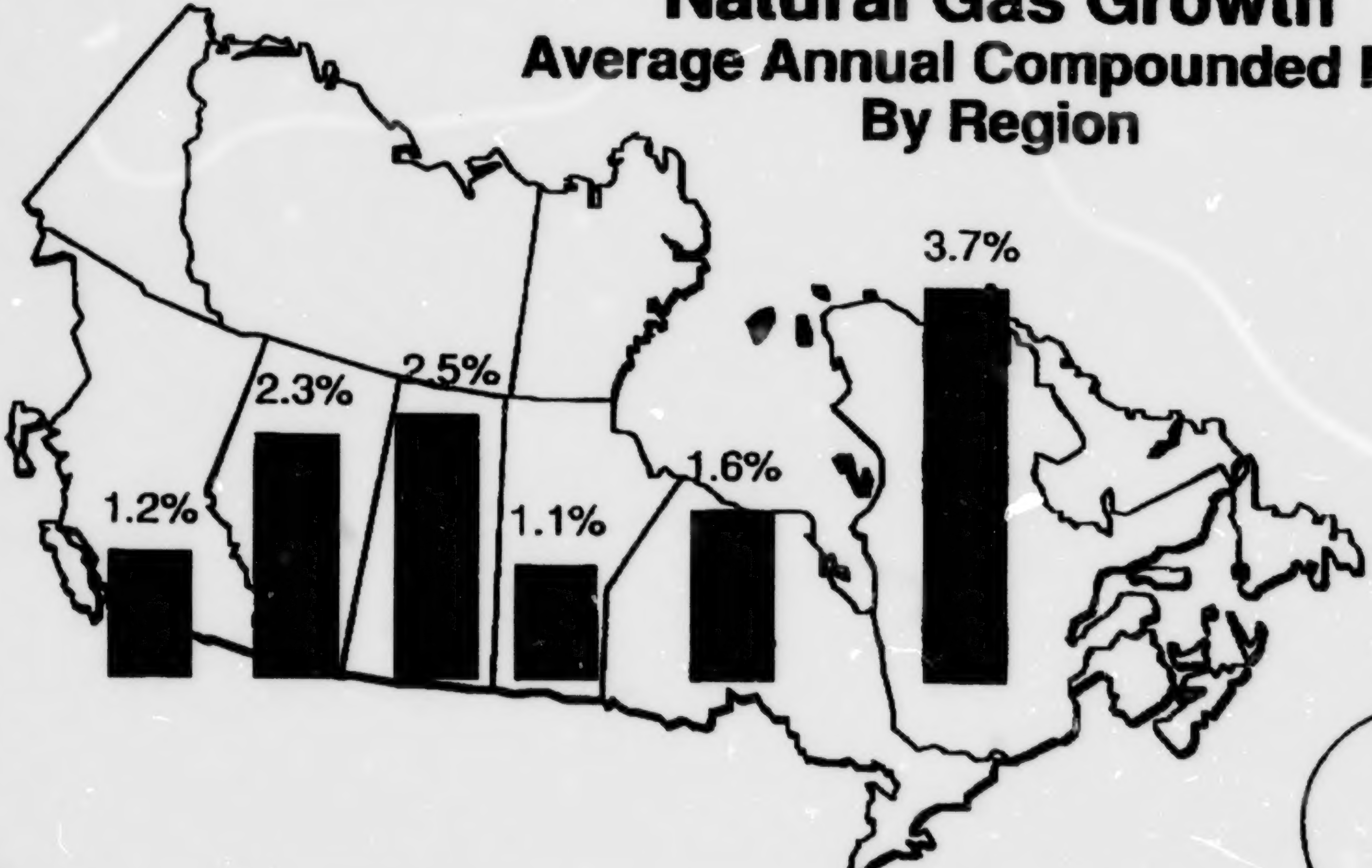
Forecast To The Year 2000

- Annual Domestic Natural Gas sales volume increases will average 2.1%
- Sales volume in the year 2000 will total 2.9 TCF

Assumptions

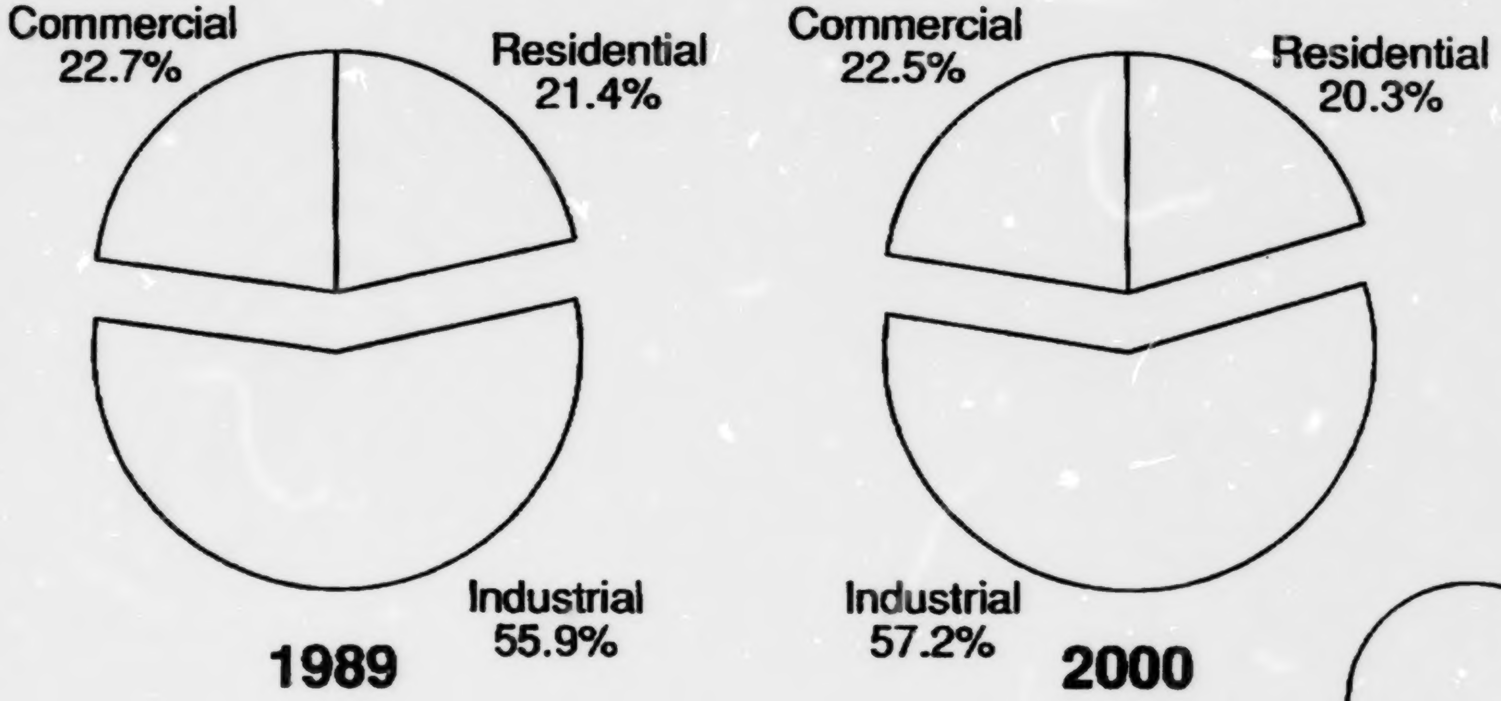
- Effect of energy conservation on gas sales will decline from 1% to .5% by the year 2000
- 2.8% average annual real growth rate in GDP
- Average annual increase in CPI of 4.6%
- Housing starts decline to 150,000 by year 2000 from 190,000 in 1989
- Average annual increase of 2% in gas prices
- Price of oil will grow by 1% annually
- No growth in electricity prices

Natural Gas Growth
Average Annual Compounded Rate
By Region

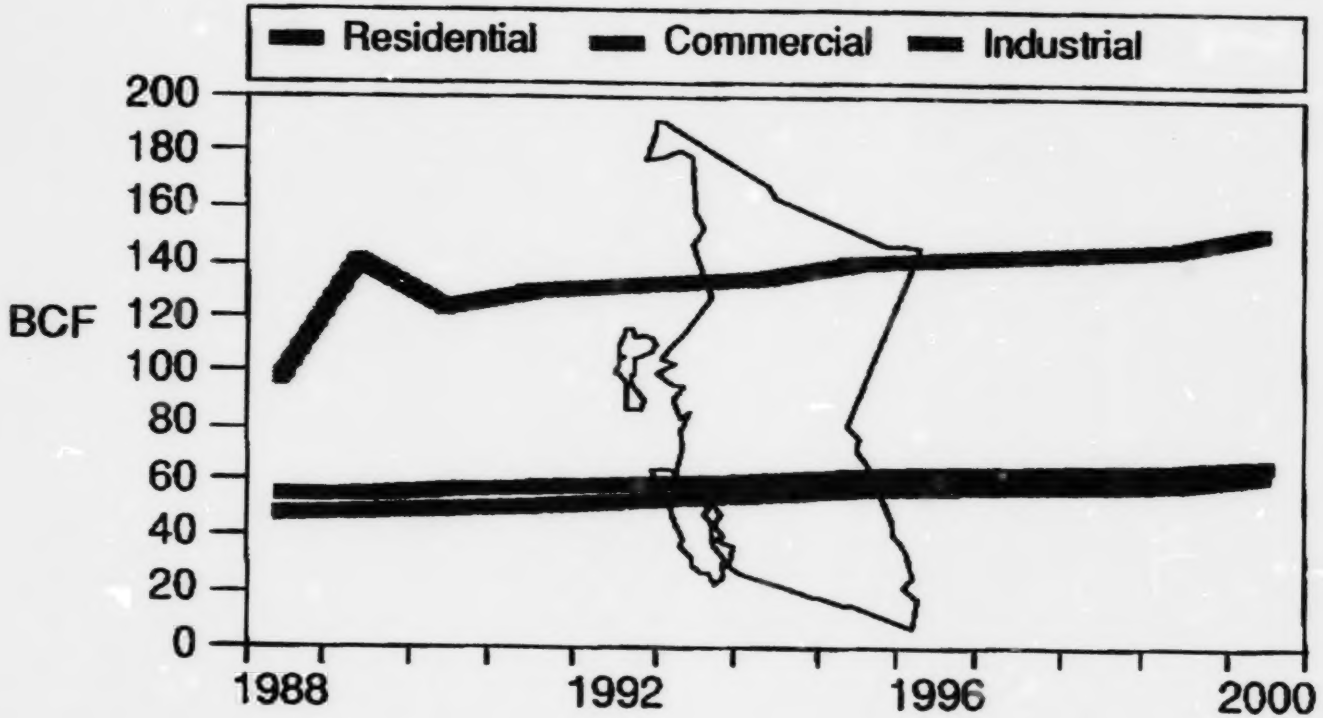


Natural Gas Demand

Sectoral Share

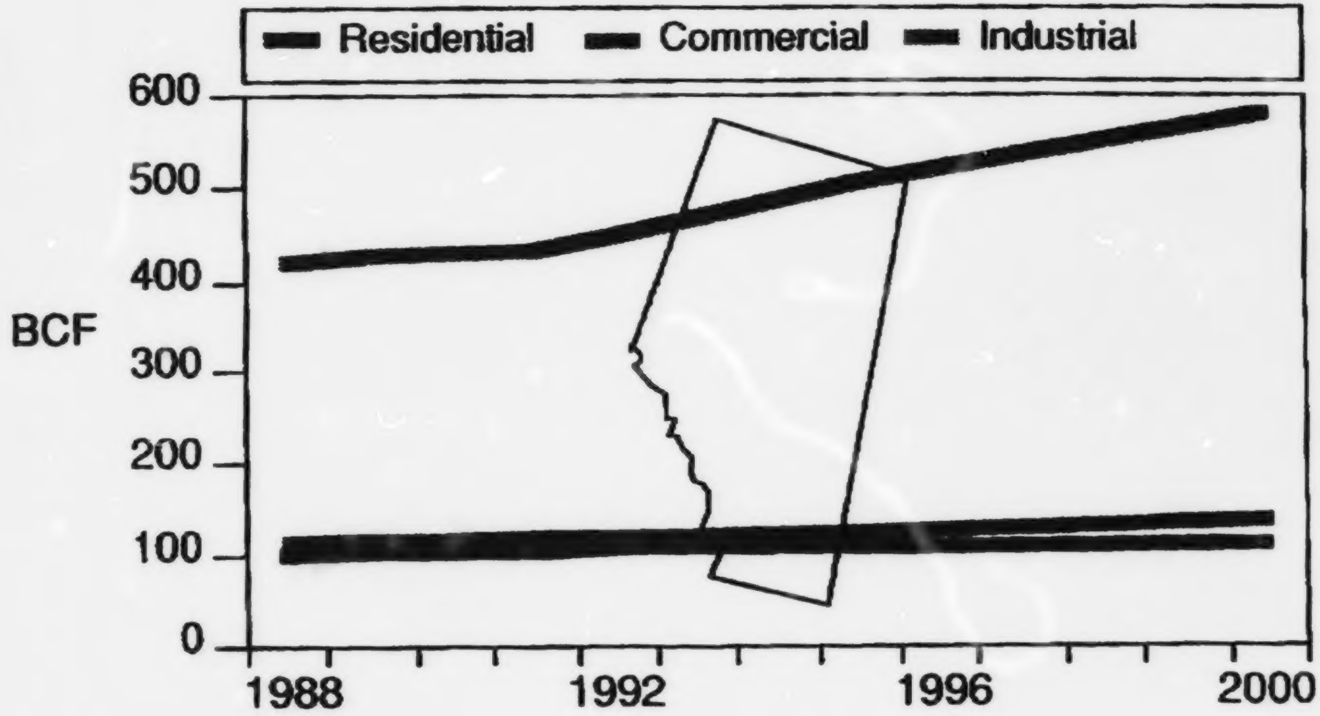


British Columbia
Natural Gas Demand



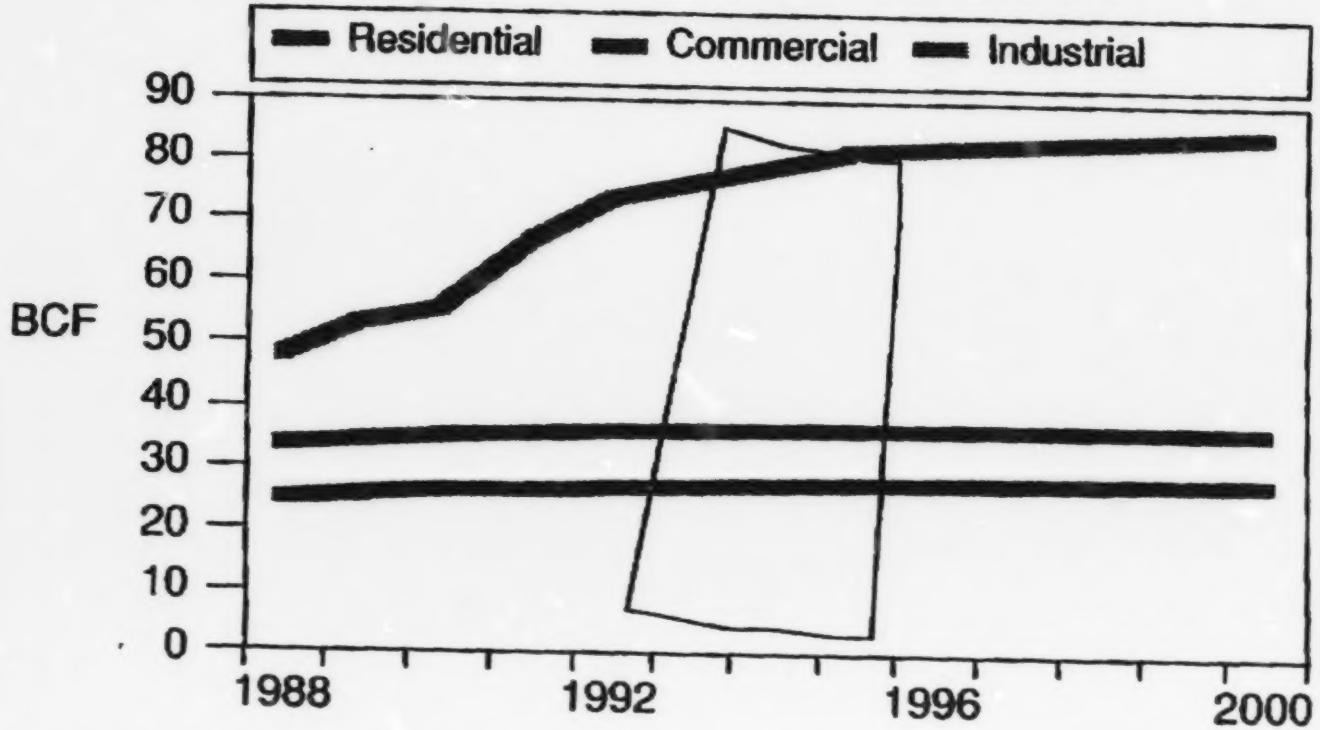
Average Annual Gas Volume Growth: 1.2%

Alberta
Natural Gas Demand



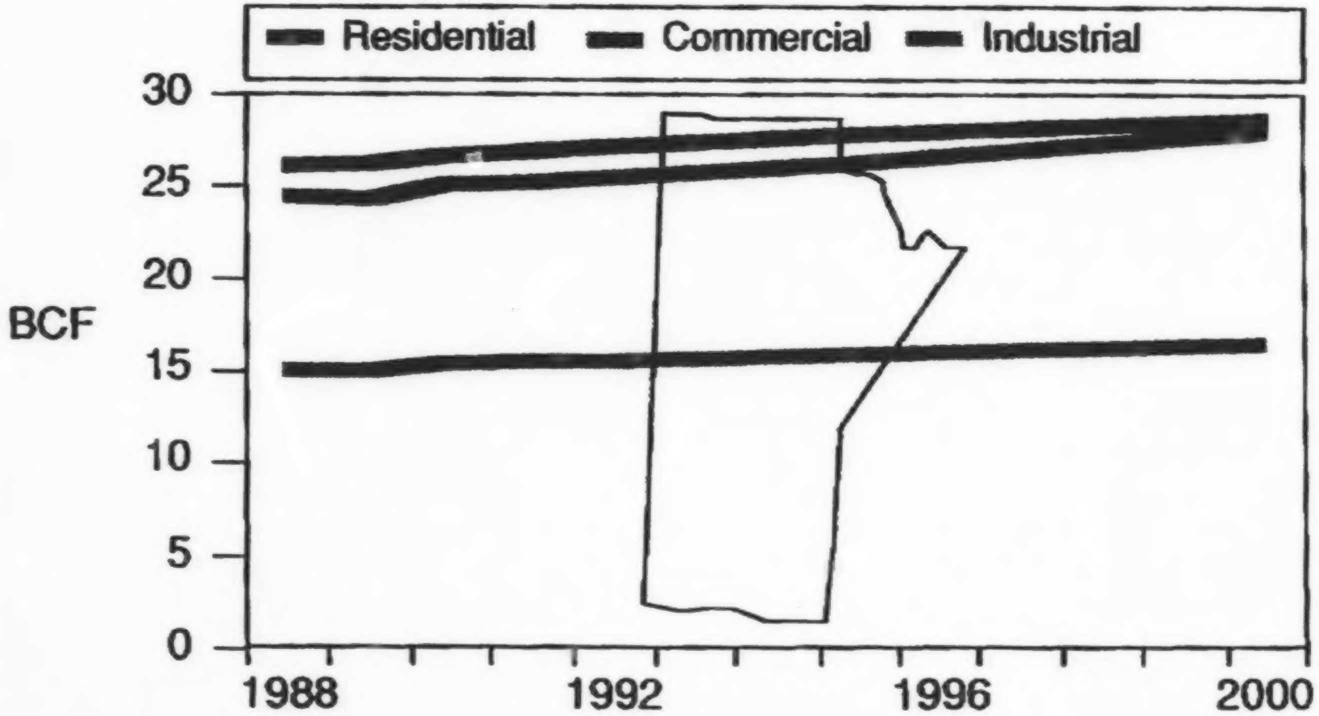
Average Annual Gas Volume Growth: 2.3%

Saskatchewan
Natural Gas Demand



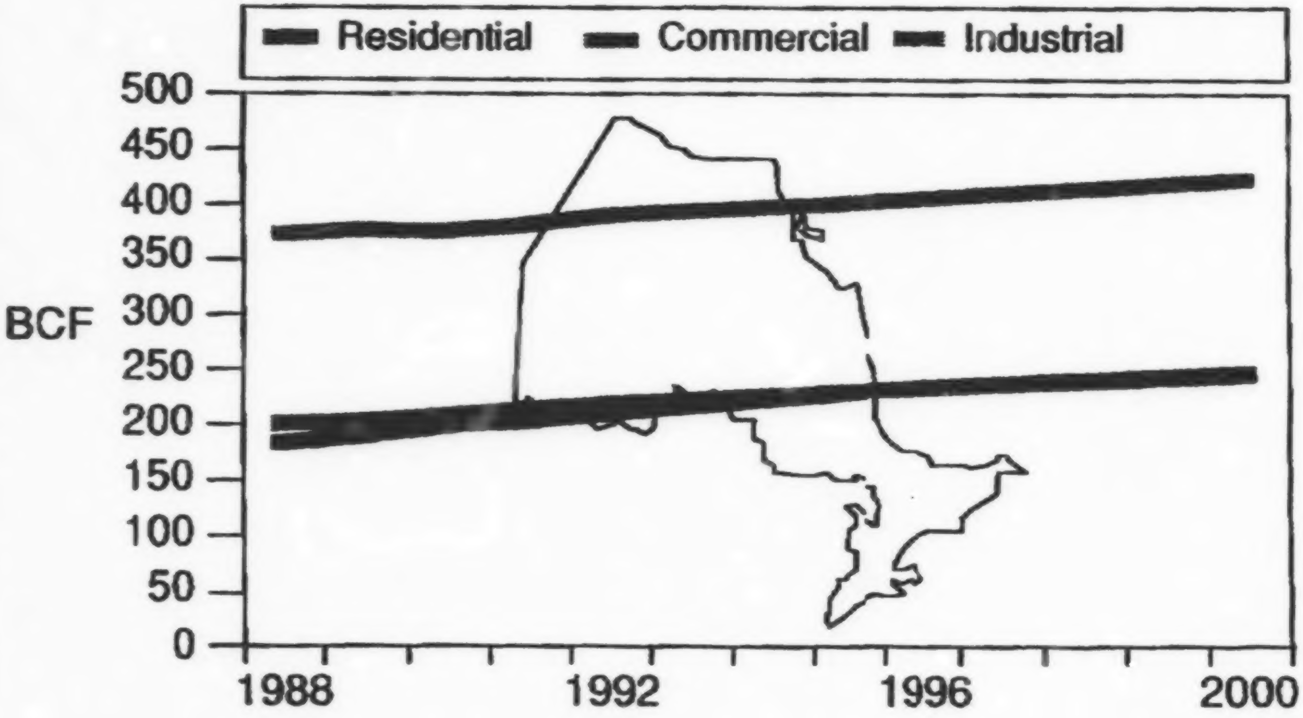
Average Annual Gas Volume Growth: 2.5%

Manitoba
Natural Gas Demand



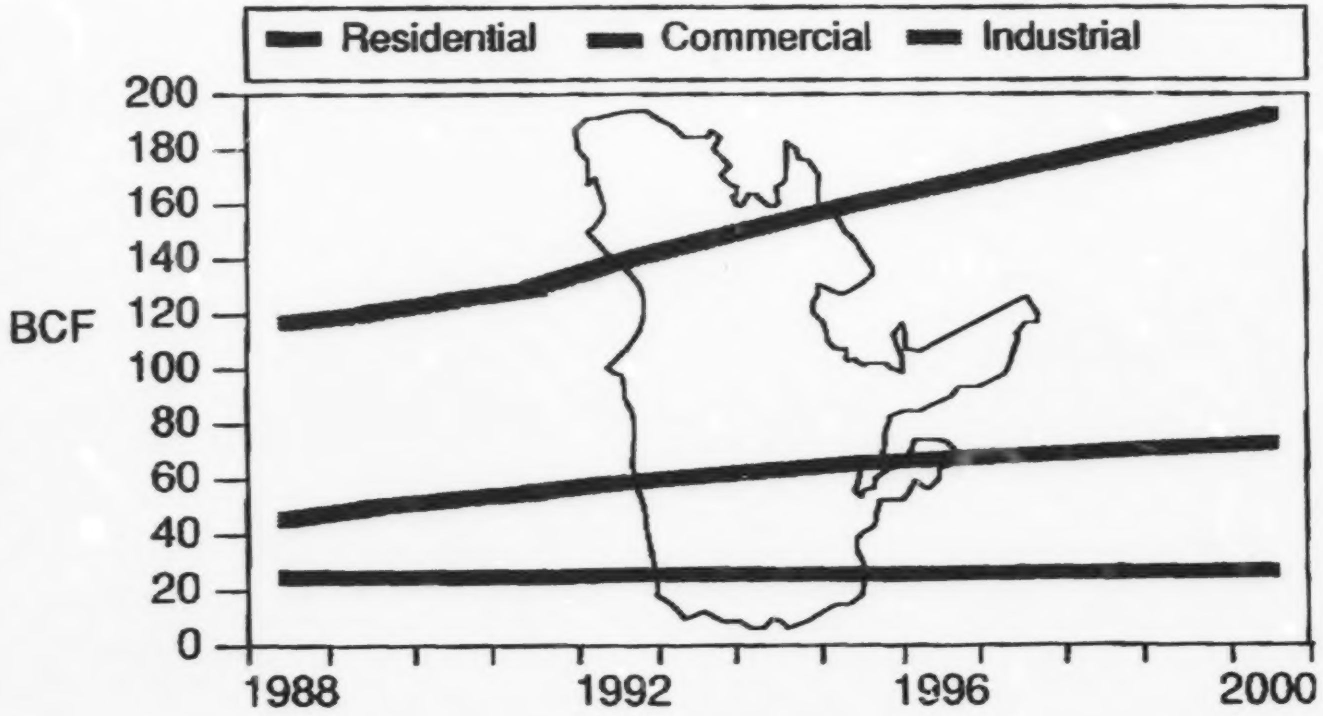
Average Annual Gas Volume Growth: 1.1%

Ontario
Natural Gas Demand



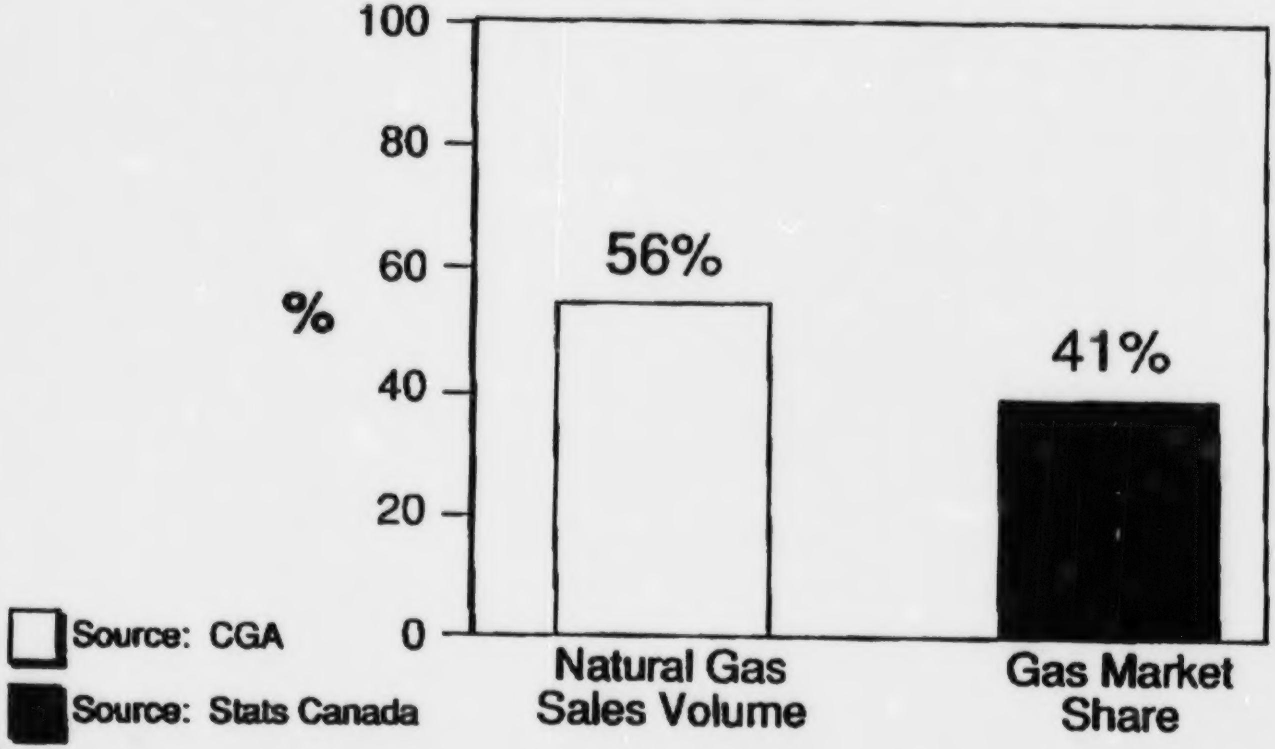
Average Annual Gas Volume Growth: 1.8%

Quebec
Natural Gas Demand

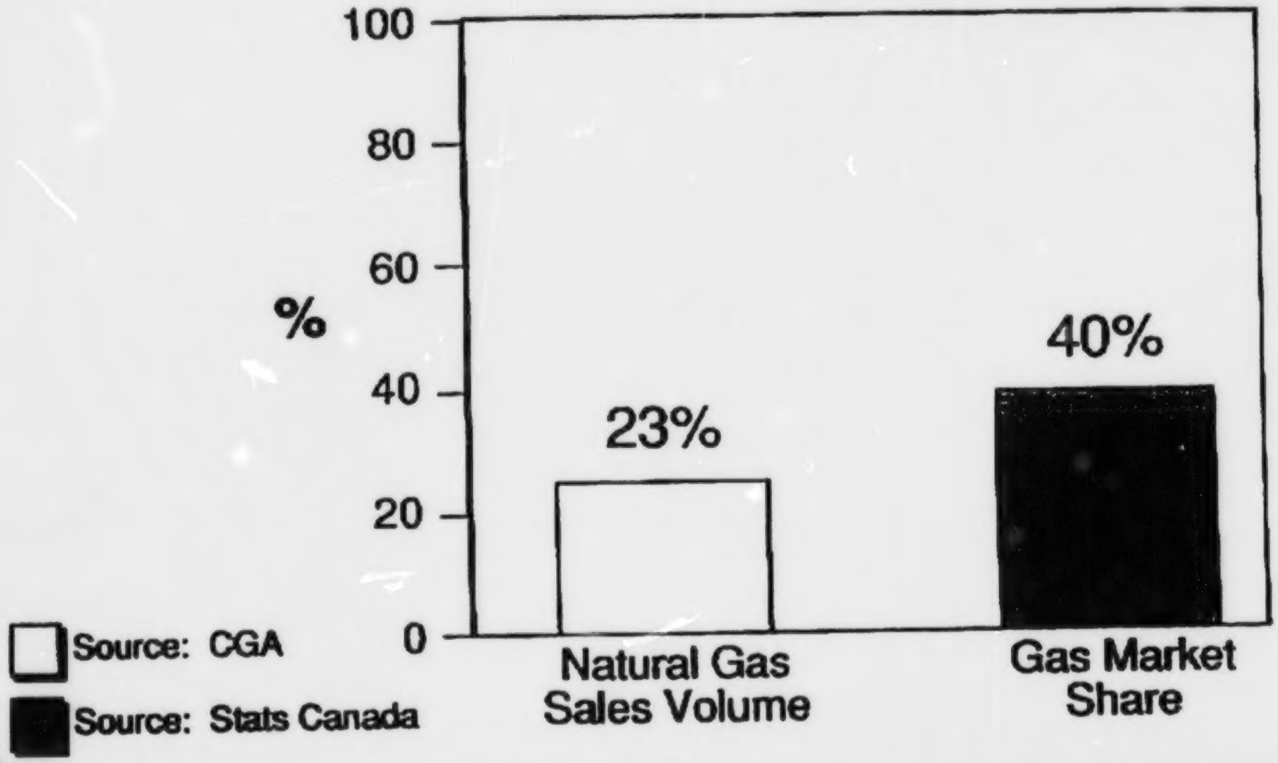


Average Annual Gas Volume Growth: 3.7%

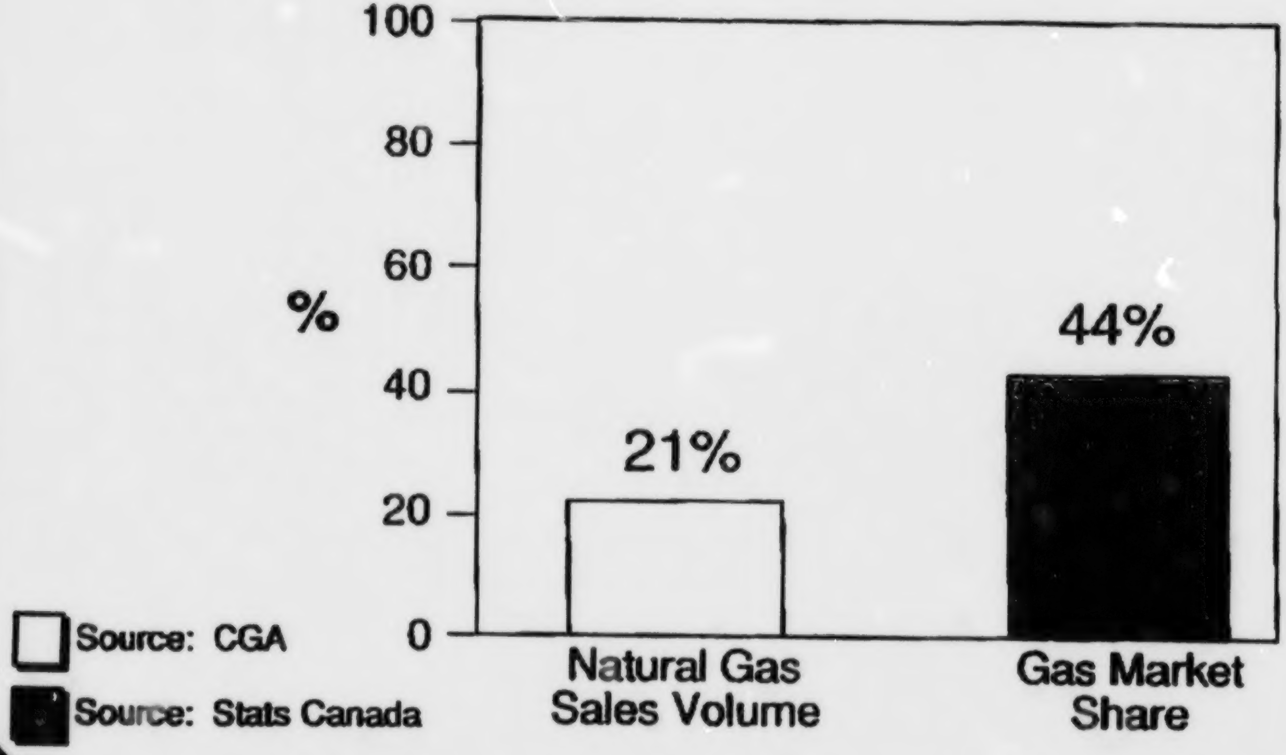
Industrial Market



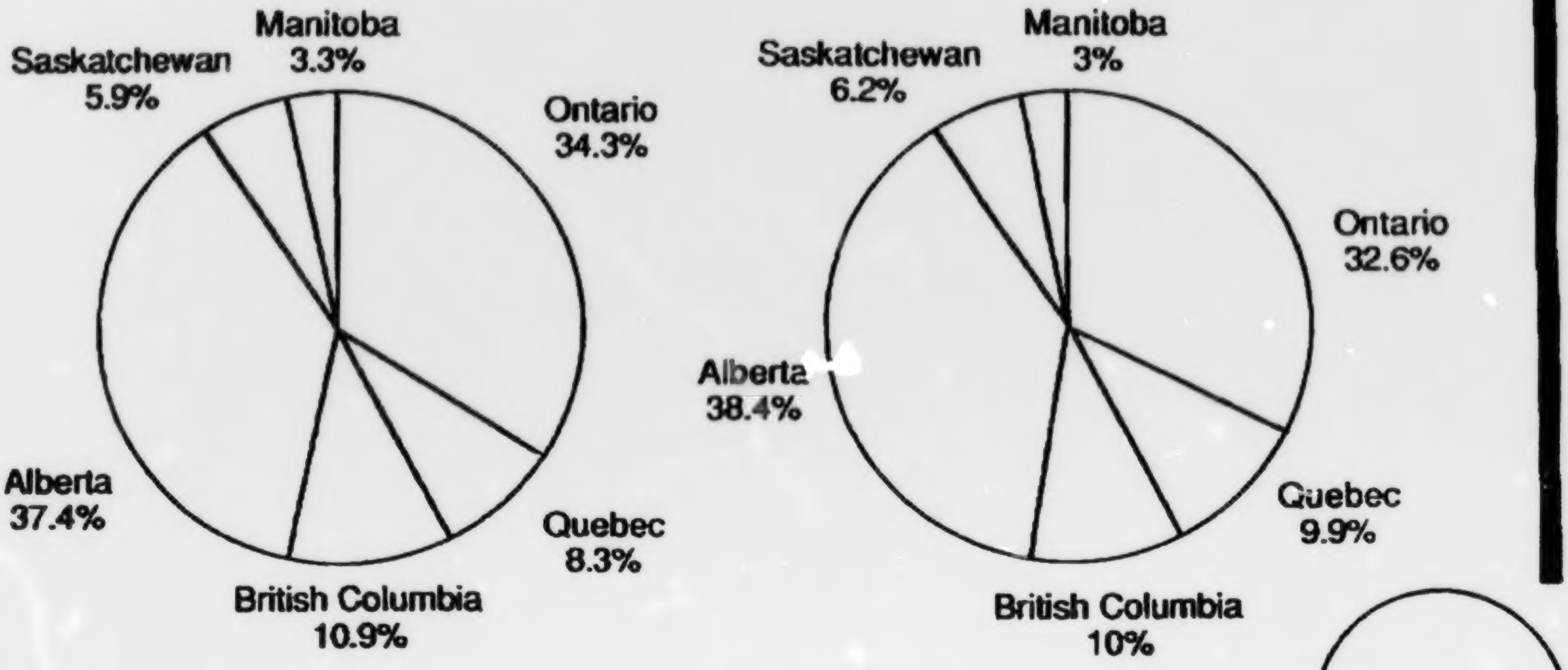
Commercial Market



Residential Market



Natural Gas Demand
Regional Share



1989

2000

Gas Cogeneration

- Incremental gas potential
  by year 2000: **250 BCF**

Gas Cogeneration

- Incremental gas potential by year 2000: **250 BCF**
- Assuming electricity prices increase faster than gas: **350 BCF**

Project Environment
1990 Funding

	$(000's)	%
Distributors	717.0	66.3
Transporters	4.6	0.4
Producers	328.4	30.2
Manufacturers	28.4	2.6
Marketers / Brokers	6.0	0.5
	1084.4	100.0

GROWTH MARKETS IN THE U.S. NORTHEAST

Presented by

Bertram D. Moll
Vice President, Gas Supply & Energy Services
Consolidated Edison Company of New York, Inc.
New York, New York

NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23 - 25, 1990

The thrust of my talk is that the market for natural gas in the U.S. Northeast is a growth market, notwithstanding the current economic slow-down in this region. I will cite the data which support this conclusion - data for the New York City area, for New York State and for the Northeast region of the United States as a whole. The extent to which growth in gas demand is likely in the Northeast is an issue currently before the United States Federal Energy Regulatory Commission (FERC) in the pending Iroquois case.

For those in this audience who may be unfamiliar with Iroquois - it is a project which would move almost 600 MDT of gas per day from Alberta to the northeastern part of the United States. But first acceptable approvals must be granted by Canadian and U.S. authorities for the construction of the necessary pipeline facilities. The project is vigorously opposed in the proceedings before FERC by the Independent Petroleum Association of America - which opposes any displacement of domestic gas by Canadian gas - by oil dealers who are threatened with loss of markets, and by others, some of whom can reasonably be described as gadflies.

So that my biases are clearly revealed, I should state that while my Company does not have an equity interest in Iroquois, it will receive gas over the Iroquois facilities when built, and I have been personally active in promoting the virtues of the project.

Subject to the truism that forecasting is a hazardous occupation, the evidence is overwhelming that the Northeast requires additional natural gas supplies, and the Administrative Law Judge in the Iroquois case so found in a September 11, 1990 decision.

At the outset, to offer some perspective, it will be useful to offer some facts about Con Edison.

Con Edison is a combined electric, gas, and steam company which provides service to about three million customers in parts of New York City and Westchester County. As indicated on Slide 1, we provide gas sales and gas transportation services to a variety of markets including residential heating customers, commercial and industrial customers, our own electric and steam departments, and the New York Power Authority. We serve virtually no large industrial loads. Con Edison buys about 200 MMDT/yr and accounts for over 1% of the total U.S. gas consumption. Because of our own power generation gas requirements (almost 100 MMDT), gas system throughput peaks in the summer when interruptible pipeline capacity is available to move boiler fuel. During the cold winter months, except at odd hours, the requirements of firm customers pre-empt the available pipeline capacity.

Slide 2 shows the Con Edison sales picture in recent years, weather adjusted, by customer class. During the period covered by this slide, the promotional efforts of the Company were directed at the small residential conversion market, and total sales increased annually by 1.8%.

Slide 3 forecasts our gas sendout requirements through the year 2000 under normal weather conditions. The forecast was made recently and contemplates the sluggish economy we are seeing. But it predated the Iraq situation and therefore does not take into account any increase in demand which could result from fears of high oil prices. While it is too early to predict whether there will be any significant switching to gas as a result of Near East uncertainties, there already are indications in our residential market that this may well occur. In fact, previous studies highlight a curious fact - that gas consumption is more responsive to changes in the oil price than to changes in the gas price.

As can be seen, the forecasted overall increase in the gas sendout will be from 203.7 MMDT in 1990 to 284.0 DT in 2000, or some 39%. In the firm customer categories, the increase in this period will be 19%, one-half of the overall growth rate. While new sales are and have been running at a much higher rate, annual sendout data reflect the result of very large conservation gains, which will persist. The annual consumption of four small residences which use gas in our territory is now no greater than the consumption of three small residences just a few years ago. Improved appliance efficiencies account for the difference. It should be noted that the Con Ed growth in gas for power generation is expected to be moderated by a combination of transportation capacity limits and by a demand side management program which will reduce customer demand for electricity.

It should also be noted that the Con Edison forecast reflects no motor vehicle load. In fact, a study made for the Company by a consultant projects that the compressed natural gas requirement for motor vehicles in our franchise area could reach more than 25 MMDT by the year 2010, an obviously very significant increase in demand.

Two other companies provide gas service in discrete territories in the New York City metropolitan area - Brooklyn Union Gas Company and Long Island Lighting Company. Slide 4 shows that they have similar views that gas requirements will increase.

In Brooklyn Union's case, total demand will rise from 129.2 MMDT to 174.8 MMDT in this decade, or 35%. For LILCO, the forecast is for a slightly less robust growth of 28% in this decade, still a substantial increase.

Slide 6 shows New York State sponsored 1989 Energy Plan data. The Energy Plan base case projects only a 7% gas demand growth in the 1990 - 2000 decade, reflecting the view that environmental requirements will continue to be less stringent outside of the New York City area than in this area. The Energy Plan also has a Low Emission scenario under which environmental requirements are closer to the very demanding ones in New York City, and under this scenario the growth is 40%.

The last projection I have was made by the United States Energy Information Administration. It looks at the region which would be served by Iroquois - New England and the mid-Atlantic states of New York and New Jersey.

As can be seen from Slide 7, the Northeast as a whole will be a growth area for gas. The total gas requirement for this region is expected to grow from 1,590 MMDT in 1988 to 2,370 MMDT in 2000. This is an annual percentage increase of 3.4%, a 70% greater annual increase than is expected for the United States as a whole.

What accounts for the growth that these authoritative projections foresee? There are several key factors. Population growth is not one of them, except to a minor extent, since population growth in the Northeast is expected to be slower than the national average. A substantial part of the anticipated gas market growth is related to the heavy current reliance of the Northeast on oil. The use of gas for home heating in the Northeast is below that elsewhere in the nation. EIA data published in May 1989* indicate that while 56% of the homes in the U.S. were heated with gas, the percentage was only

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* Residential Energy Consumption Survey; Housing Characteristics, 1987.

44% in the Northeast. The gas space heating saturation in Con Edison's area is only 50%. But our experience is that gas is used for heating in 92% of the new houses built in our area. Clearly, there is an overwhelming customer preference for gas. And therefore it is reasonable to expect that as current oil burning equipment requires replacement, gas will be substituted for oil. It is also reasonable to expect that homeowners will accelerate the conversion time table to enjoy the savings provided by more efficient units and relatively low gas costs, particularly if fears of high oil prices persist. That the cost of oil has jumped about 60% to about $32 per barrel since July 15 has not gone unnoticed by a public which is already complaining loudly about higher gasoline prices. Unless tensions ease in the Near East and oil prices recede, home owners who heat with oil will get their rate shock with their next oil tank fill-up. In the meantime gas prices remain relatively low, and there is skepticism that competitive conditions in the gas industry will leave much room for more than a seasonal increase in the coming months.

Other factors which will tend to increase gas use in the Northeast, though slowly and without measurable impact before the end of the decade, are the compulsion to find alternatives to gasoline as a motor fuel, and introduction of gas air conditioning in this area as an electric peak shaving measure. As indicated by the study of the potential in the Con Edison franchise area for compressed natural gas for vehicles, which I mentioned earlier, transportation use will be a growth market for natural gas later in this decade. By far the largest contribution to expanded gas use will come from the power generation sector.

To a depressing degree, utilities in the U.S. find themselves under siege when they propose to build new facilities, even facilities vital to performance of their service obligations. Bloodied and bowed by failed attempts to provide new, large central station generating facilities, many electric utilities are being relieved of the problem by state regulators who are promoting the use of independent power producers. They have also decided to bow to the prevailing view that smaller is better, particularly since adapting to the new arrangements avoids huge capital commitments at a time when the regulators are reducing allowable returns on equity. And so, for example, my Company has no plans for any new central station facilities. Instead, we have signed contracts for over 1,700 MW of electric capacity to be provided by IPPs. The expectation is that about 1,000 MW of this amount will be available by the mid 1990's.

All of this capacity will be primarily gas-fired, to meet strict new anti-pollution legislation which is coming. Such legislation could require low-emission utilities such as Con Ed to adhere to the average of their 1985 - 1987 SO_2

emission levels. If so, the Company will have little flexibility to use fuel oil containing sulfur in new plants. Required reductions in SO_2 and emissions will be brought about either by costly retrofits, fuel switching or by allocation of emission allowances from existing facilities. Once the allowance system is effective, no existing generating facilities can emit SO_2 unless allowances are available to offset these emissions. Generally, new generating facilities are not entitled to receive allowances. Violations would result in costly penalties.

Not only is Con Edison depending on this large new gas-fired production to meet future electric requirements, but we have also embarked on a recent program to convert 1,511 MW of additional generating capacity to enable us to burn gas as well as the current fuel, oil. Even without these conversions we will burn close to 100 billion feet of gas a year in our own system for power generation, as I showed on Slide 1. Moreover, we annually have between 10 billion and 35 billion feet a year of unsatisfied boiler fuel demand, a shortfall which will persist if not grow because of what may become chronic shortages of transmission capacity.

The environmental imperatives which are motivating Con Edison are similarly affecting other electric companies in the region. The burgeoning power generation market is a huge market. While power producers with dual-fuel facilities historically have based their fuel decisions on cost, we may well be rapidly approaching a change of ground rules dictated by environmental considerations. In short, the use of gas may be mandated, if it is available, even if it costs more than oil.

For those of us charged with supply responsibilities, the voices insisting that there is no growth in our future are not at all persuasive. Our nightmare - considering the growth which our perceptions tell us is inevitable - is that we won't be able to meet the demand.

The possibility exists that domestic U.S. sources, with modest supplementation from Canada and abroad, will not economically be sufficient to meet growing demands. However, the mainstream estimates of the United States Department of Energy and of the Potential Gas Committee, an industry group assisted by the Colorado School of Mines, are that economically recoverable U.S. lower 48 state reserves approximate 775 TCF. Annual requirements are expected to reach about 22,000 MMDT by 2000. This suggests that there are approximately 40 years worth of economically recoverable reserves in the U.S. and goes far in allaying fears of a gas shortage. This is particularly true since the estimates essentially rely on current technology and there is probably a very substantial understatement of gas known to exist - for example, coal seam gas. The threat of a deliverability shortage is very real, nevertheless, because of the lengthy delays in our regulatory system.

The Iroquois project is now several years past due. The initial delivery date was to be November 1, 1988 and our contract optimistically provided that it would begin "on November 1, 1987 if timely regulatory approvals permit." Yet the likelihood that my Company will receive any Iroquois gas before 1992 is increasingly remote, even assuming that the sponsors press forward while court appeals are pending. For other Iroquois customers start-up could occur in late 1991, at best, because they are less dependent on time-constrained construction.

While Iroquois may be an aggravated case of regulatory hardening of the arteries, the sad fact is that years of delay must be anticipated before new pipeline projects can be brought into service. The threat that there will be inadequate pipeline capacity is so great that the New York Power Pool has begun a study to determine whether the planned reliance on gas-fired IPPs is prudent in light of the massive new demands which are expected to materialize in the Northeast. In fact, without our pending Canadian projects, Con Edison will not be able to meet design weather demands in 1991.

There are glimmers of hope. The pipelines which traditionally have served the Northeast have rediscovered their market. The non-responsiveness of these pipelines to customer requirements resulted in the customer revolt which took the form of the Iroquois project. Having acquiesced in the construction of Iroquois - though not before waging war against it - our pipeline suppliers appear determined not to repeat past mistakes as far as expansion is concerned. For example, two pipelines are in the preliminary stage of planning a major new expansion of capacity incremental to Iroquois to serve the expanding needs of my Company, Brooklyn Union and LILCO. One of these projects will likely be realized.

If the Iroquois project has awakened the traditional pipeline suppliers to the Northeast from their sleep - and I believe it has - and if FERC can solve the procedural problems which make for supply uncertainty - there will indeed be healthy growth in gas demands in the Northeast.

I would therefore like now to combine some business with the pleasure of addressing this audience. Assuming that Iroquois is built, I am prepared to explore with any of you an additional purchase by Con Edison for delivery by Iroquois II.

CONSOLIDATED EDISON CO. OF NEW YORK

GAS SYSTEM
(1990 Est.)

CUSTOMER SENDOUT	104
FIRM	14
INTERRUPTIBLE (ex. POWER GENENERATION)	90
TRANSPORTATION	14
GAS FOR POWER GENERATION	98
NO. OF ACTIVE METERS (000)	1,021
AREA SERVED (SQ. MILES)	471
POPULATION SERVED (000)	4,175
REVENUE ($MILLIONS)	690
MILES OF MAINS	4,109
SERVICE TERRITORY	PARTS OF NEW YORK CITY AND WESTCHESTER COUNTY

CON EDISON GAS SALES
(MMDT)*

	1986	1987	1988	1989	ANNUAL % CHANGE '86-89
FIRM					
RESIDENTIAL	48.5	48.4	49.5	49.8	0.7%
COMM./IND.	33.0	33.1	33.7	34.2	0.9%
SUB-TOTAL	81.5	81.5	83.2	84.0	0.8%
INTERRUPTIBLE	10.7	10.9	12.0	11.2	1.1%
ELEC./STEAM/CO-GEN.	83.2	88.7	84.4	93.1	2.9%
SUB-TOTAL	93.9	99.6	96.4	104.3	2.7%
TOTAL SALES	175.4	181.1	179.6	188.3	1.8%

* WEATHER ADJUSTED

CON EDISON
Gas Sendout Requirements
MMdt

	1990	1995	2000	Annual % Change '90–95	 '95–00	 '90–00
Firm						
Residential	53.5	58.0	62.4	1.6%	1.5%	1.6%
Commercial/Industrial	36.8	41.3	44.9	2.3%	1.7%	2.0%
Sub–total	90.3	99.3	107.3	1.9%	1.6%	1.7%
Interruptible						
Interruptible	11.4	11.7	11.7	0.5%	0.0%	0.3%
Elec./steam/co–gen	102.0	103.6	104.0	0.3%	0.1%	0.2%
Sub–total	113.4	115.3	115.7	0.3%	0.1%	0.2%
Total Sendout	203.7	214.6	223.0	1.0%	0.8%	0.9%
IPP	0	61.0	61.0	N/A	0.0%	N/A
Total Sendout Incl. IPP	203.7	275.6	284.0	6.2%	0.6%	3.4%

Source: Con Edison's Planning Department

BROOKLYN UNION GAS
Gas Sendout Requirements
MMdt

				Annual % Change		
	1990	1995	2000	'90–95	'95–00	'90–00
Firm						
Residential	89.2	99.4	111.0	2.2%	2.2%	2.2%
Commercial/Industrial	17.0	18.9	21.1	2.1%	2.2%	2.2%
Sub–total	106.2	118.3	132.1	2.2%	2.2%	2.2%
Interruptible						
Residential	12.3	19.1	26.1	9.2%	6.4%	7.8%
Commercial/Industrial	5.3	8.2	11.2	9.1%	6.4%	7.8%
IPP/Co–generation	5.4	5.4	5.4	0.0%	0.0%	0.0%
Sub–total	23.0	32.7	42.7	7.3%	5.5%	6.4%
Totals						
Residential	101.5	118.5	137.1	3.1%	3.0%	3.1%
Commercial/Industrial	22.3	27.1	32.3	4.0%	3.6%	3.8%
IPP/Co–generation	5.4	5.4	5.4	0.0%	0.0%	0.0%
Total Sendout	129.2	151.0	174.8	3.2%	3.0%	3.1%

Source: Brooklyn Union's Planning Department

LILCO
Gas Sendout Requirements
MMdt

	1990	1995	2000	Annual % Change '90–95	'95–00	'90–00
Firm						
Residential	36.4	42.2	49.2	3.0%	3.1%	3.1%
Commercial/Industrial	17.1	22.0	28.5	5.2%	5.3%	5.2%
Sub–total	53.5	64.2	77.7	3.7%	3.9%	3.8%
Interruptible/ Electric	30.2	31.2	29.8	0.7%	–0.9%	–0.1%
Total Sendout	83.7	95.4	107.5	2.7%	2.4%	2.5%

Source: Lilco's Planning Department

NEW YORK STATE
Gas Requirements
MMdt

	1990	1995	2000	Annual % Change '90–95	'95–00	'90–00
Firm						
Residential	386.8	384.0	378.1	–0.1%	–0.3%	–0.2%
Commercial	156.3	157.4	158.7	0.1%	0.2%	0.2%
Industrial	92.4	102.5	112.3	2.1%	1.8%	2.0%
Losses	27.4	27.8	28.5	0.3%	0.5%	0.4%
Sub–total	662.8	671.7	677.6	0.3%	0.2%	0.2%
Interruptible/ Power Generation/ IPP						
Base Case	180.6	265.7	253.4	8.0%	–0.9%	3.4%
Low Emissions Case	183.4	437.2	508.1	19.0%	3.0%	10.7%
Total Sales: Base Case	843.4	937.4	931.0	2.1%	–0.1%	1.0%
Total Sales: Emissions	846.2	1,108.9	1,185.7	5.6%	1.3%	3.4%

Source: 1989 New York State Energy Plan

Energy Information Administration
Natural Gas Consumption Forecast – Base Case
New England* and Mid–Atlantic** Regions
Trillion BTU

	***			Annual % Change		
	1988	1995	2000	'88–95	'95–00	'88–00
New England						
Residential	180	200	200	1.5%	0.0%	0.9%
Commercial	100	100	100	0.0%	0.0%	0.0%
Industrial	60	60	70	0.0%	3.1%	1.3%
Electric Utility	20	90	180	24.0%	14.9%	20.1%
Total New England	360	450	550	3.2%	4.1%	3.6%
Mid–Atlantic						
Residential	550	580	570	0.8%	–0.3%	0.3%
Commercial	300	290	280	–0.5%	–0.7%	–0.6%
Industrial	170	200	210	2.3%	1.0%	1.8%
Electric Utility	210	540	760	14.4%	7.1%	11.3%
Total Mid–Atlantic	1,230	1,610	1,820	3.9%	2.5%	3.3%
Total NE + Mid–Atlantic						
Residential	730	780	770	1.0%	–0.3%	0.4%
Commercial	400	390	380	–0.4%	–0.5%	–0.4%
Industrial	230	260	280	1.8%	1.5%	1.7%
Electric Utility	230	630	940	15.5%	8.3%	12.4%
Total	1,590	2,060	2,370	3.8%	2.8%	3.4%
United States						
Residential	4,750	4,840	4,820	0.3%	–0.1%	0.1%
Commercial	2,760	2,730	2,680	–0.2%	–0.3%	–0.2%
Total United States	16,790	19,290	21,340	2.0%	2.0%	2.0%
% of Total US	9.5%	10.7%	11.1%	1.7%	0.8%	1.3%

* Maine, Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island.

** New York and New Jersey

*** Actual

Source: EIA, "Annual Outlook for Oil and Gas 1990"

NATURAL GAS DEMAND IN THE MIDWEST U.S. MARKET

Presented by

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NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

The earliest weather forecast on record is Noah's forecast of rain and flood. It had never rained up to that time so I suspect that Noah's audience believed that there was a low probability of either a rain or a flood and therefore, they took no action. A forecast has value only if it provides direction and influences people to take action. Noah could look back and say that his forecast of both the rain and the flood was accurate (if not precise) but his message of a call to action and for changes was ignored. Noah's forecast was accurate but of little value.

There are many different forecasts of gas demand for the Midwest U.S. which where prepared by experienced organizations. We can view them as either a prediction of the future or a call to action. Would a forecast of an increase in demand for gas give you comfort? Then be comfortable because I have a high demand case. Would you prefer a forecast that shows no change in demand from today's level? I have one of those also. And I can show you a middle of the road forecast. Forecasts do not create markets but the rationale offered to support a predicted change in current levels can influence actions that will then achieve the forecasted levels. And if no actions are taken then a low case forecast will probably become a reality. In the high case forecast shown in Exhibit I the main reasons for the rise in demand are increases in use of gas for the automotive and transportation markets and increased use of gas for the generation of electricity. Before either or both of those changes take place, some very serious cooperate effort will have to be initiated because if left to "others" or to chance this change in demand will not take place.

In other forecasts increases in demand in some market sectors are offset by a loss of a portion of the gas spaceheating market to electric units and a continuing decline in usage per customer resulting from the replacement of older gas appliances with new gas appliances having higher utilization efficiencies. Each of us can develop a forecast to support our various positions but it is the elements that comprise a forecast that are most important because there are various degrees of control over the individual parts.

My forecast of gas demand for the midwest U.S. takes into consideration the following:

1. As shown by Exhibit 2, from 1980 to 1990 the population of the midwest U.S. was relatively stable and that trend will continue. If there is no population growth then the demand for new housing units will be dependent upon the need to replace older units with new units and newer housing units require less gas for space conditioning.
2. New gas appliances are much more efficient than older equipment, (particularly spaceheating equipment) and the rate of replacement of all gas appliances can be accurately determined.
3. Natural gas cooling in residential and commercial applications will be a growing market.
4. New home construction needed to replace demolitions and to accommodate the decline in family size will be more energy efficient than older stock.
5. The electric industry will not capture a material share of the spaceheating market.

6. Over the past several years some users of large quantities of energy displaced coal and burned natural gas because of marginal burner tip price differentials and those large energy users will return to coal as wellhead gas prices increase and pipeline rates for transportation service more closely approximate transportation rates for pipeline sales service.
7. There will be renewed interest in the need to conserve energy.
8. Use of natural gas by electric utilities will not increase.
9. Use of natural gas for environmental purposes will be optional and not mandated.
10. Use of natural gas as a fuel for motor vehicles will not be a significant market over the next ten years.

Exhibit 3 shows MichCon's markets for the past five years and five years into the future. MichCon's current markets and market opportunities are similar to the total midwest market. The composition of our market will change. If we take no new actions to increase our markets and offset predictable declines then my forecast for the future would be much different and much lower. It will take work and a change in attitude throughout the gas industry to retain existing markets and add new markets in sufficient quantity to offset anticipated and predictable declines in certain market segments.

For the midwest U.S. my high case for gas demand is maintenance of current levels and a lot of work is required in order to accomplish that result. We can increase our gas markets but those increases will probably not translate to higher demands in gas supply.

All segments of the gas industry have experienced significant changes in the way we plan and operate our business and serve our markets. More change is needed. At the distribution level we need to retain the flexibility we now have that provides us the opportunity to effectively compete with all other energy alternatives.

Distributors now need to discard most of their traditional business concepts which have created barriers to increasing gas markets and retaining current markets. For example, investments by gas distributors in residential, commercial and industrial gas equipment should be given the same consideration as decisions to expand underground distribution facilities to serve new customers. A decision to install pipe in the ground to sell more gas is not any different than a decision to invest in a gas-fired boiler, or a re-heat furnace or restaurant equipment or a blast furnace. Of course one of the barriers to this approach to marketing gas is our view of regulation. Too often we use regulation as a reason not to take action and we stifle innovation. Regulations were not intended to prevent the gas industry from marketing its product or services. If regulation gets in the way of logic then change the regulation and stop rewarding people for telling you how or why you cannot or should not exercise sound business judgement and initiate new marketing programs.

At the federal level the expansions of gas markets are impeded by regulators and regulations. Regulations were initially considered to be necessary to protect the public and to provide for reasonable and economic expansion of facilities. Those initial decisions to develop regulations and to alter those regulations on an as needed basis were good decisions based upon the perceived need at that time for control and protection. But we are well into a mature market situation and it is no longer clear who is being protected. If somebody believes that there are gas market opportunities in the Northeast U.S. and they want to develop the market and build major facilities and dedicate supply to that area then I believe they should be able to proceed on a timely basis while the opportunity exists. And if the shareholders of other corporations believe that they want to compete to serve the same northeast market then let them proceed also. Why should a regulatory process delay projects for years while regulators try to decide who has the best plan or the lowest cost? In a mature market situation the market will ultimately decide who offers the best service and I seriously doubt that more than one system would be constructed even if all were authorized to proceed. But that risk rests with the supplier and not the customer. When regulation goes beyond its useful life as it has in the U.S. at the federal level, then that part of the regulatory scheme that stifles growth and causes injury to those that were supposed to be protected must be quietly laid to rest.

Another example of federal regulation gone astray is the highly publicized gas inventory charge or GIC's. If you read everything that is written about GIC's you will conclude that they are designed to accomplish many purposes but a prime purpose is to assure a stable supply of gas from the producer to the customer. If we are attempting to influence producers to provide a stable or even a growing supply of marketable gas, wouldn't it be better to establish a two part rate design for gas prices at the wellhead instead of a gas inventory charge at the pipeline level? A two part rate design could assure producers of a steady cash flow through a demand charge and a fixed or variable commodity charge for gas taken could accommodate variances in market conditions.

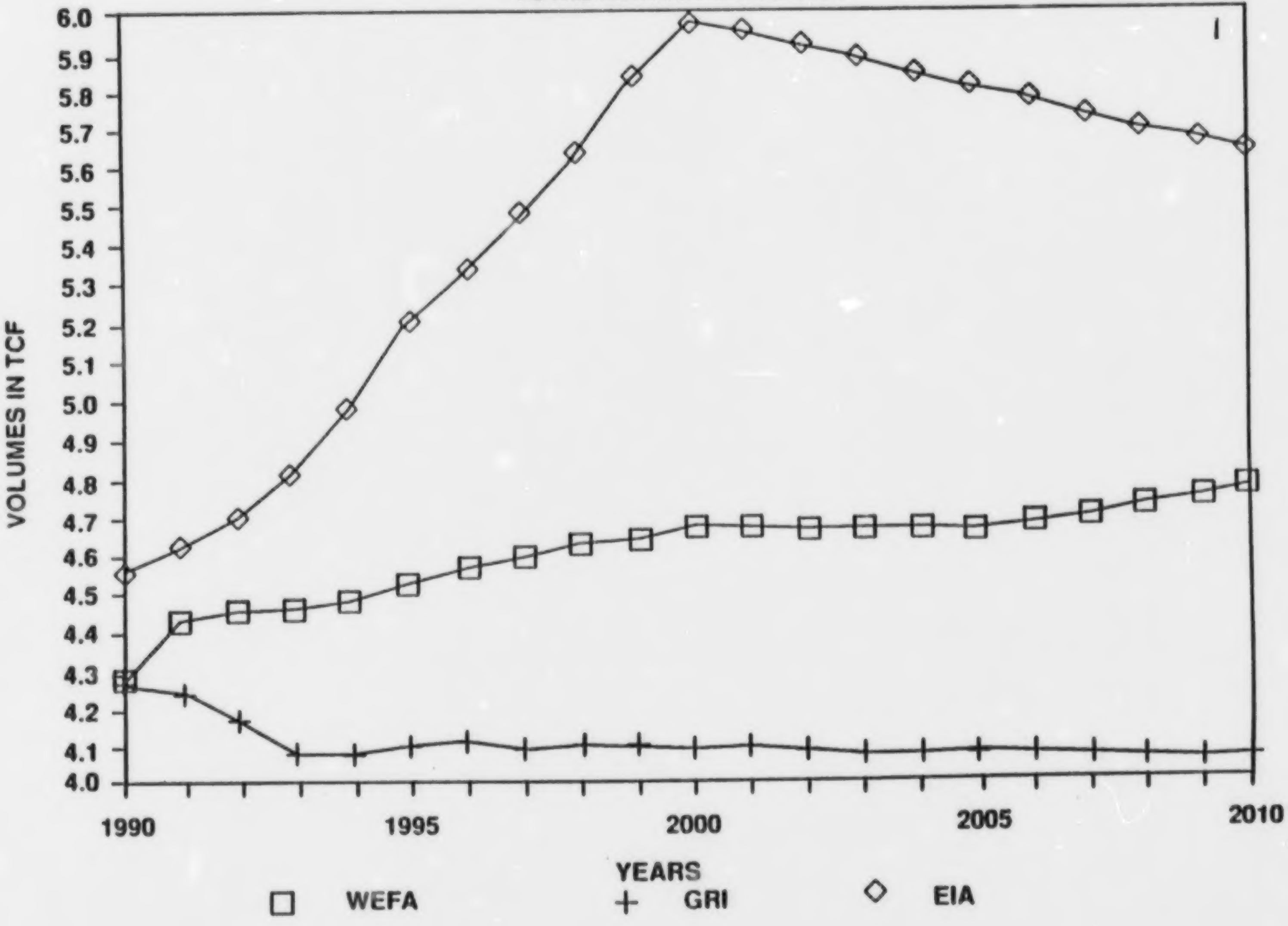
And would it not be more market efficient to ship gas from Canada and Alaska to the western part of the U.S. and back other supply out of those areas of the U.S. and re-route that domestic supply to the Northeast through existing and any required new facilities?

Forecasts are useful if they contain sufficient information to provide direction. The available forecasts of gas demand in the U.S. show that the level of demand that we in the industry want is dependent only upon the effort, unity and creativity of producers, pipelines and distributors.

MIDWEST NATURAL GAS DEMAND

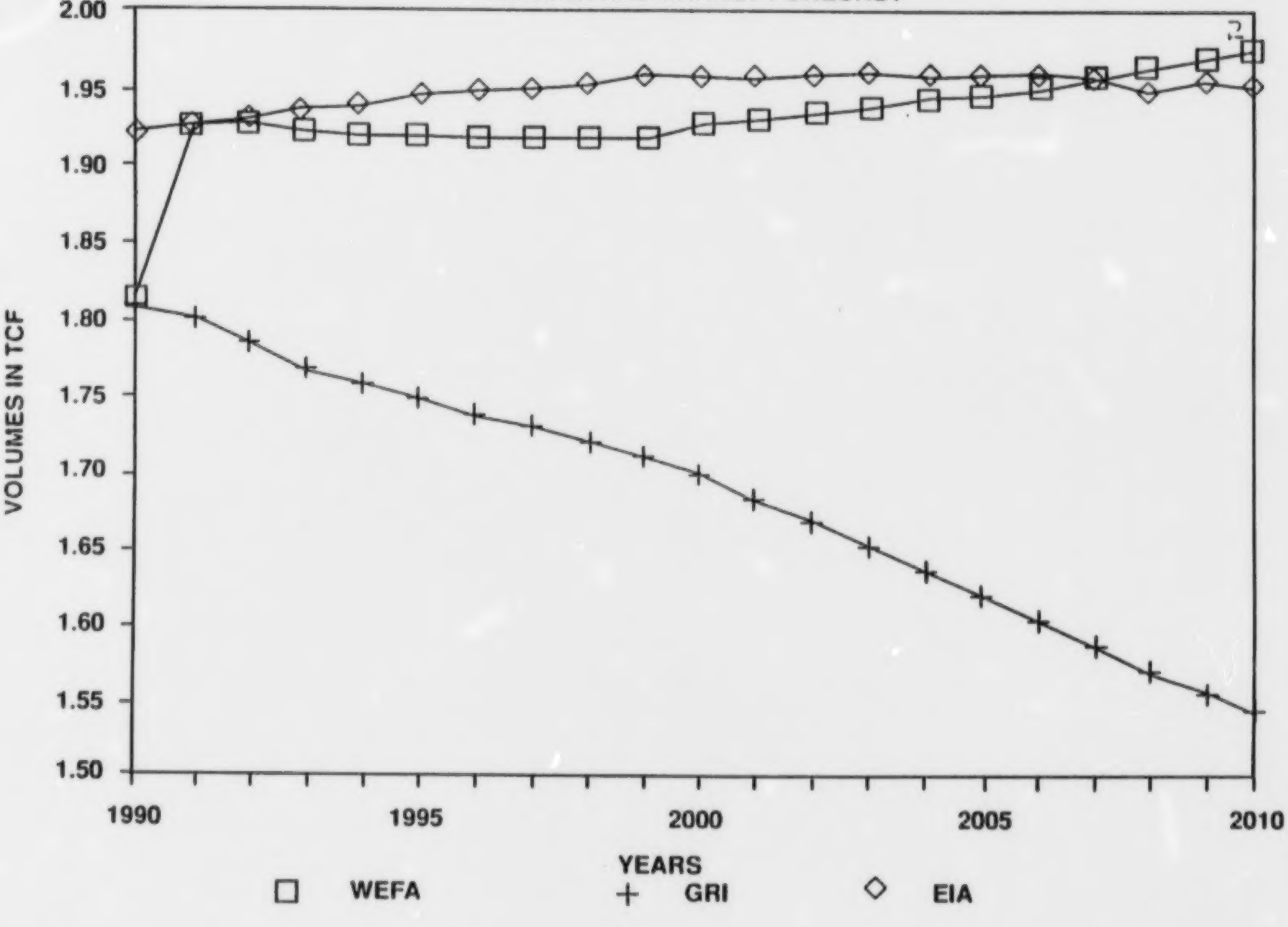
TOTAL MARKET FORECAST

EXHIBIT I



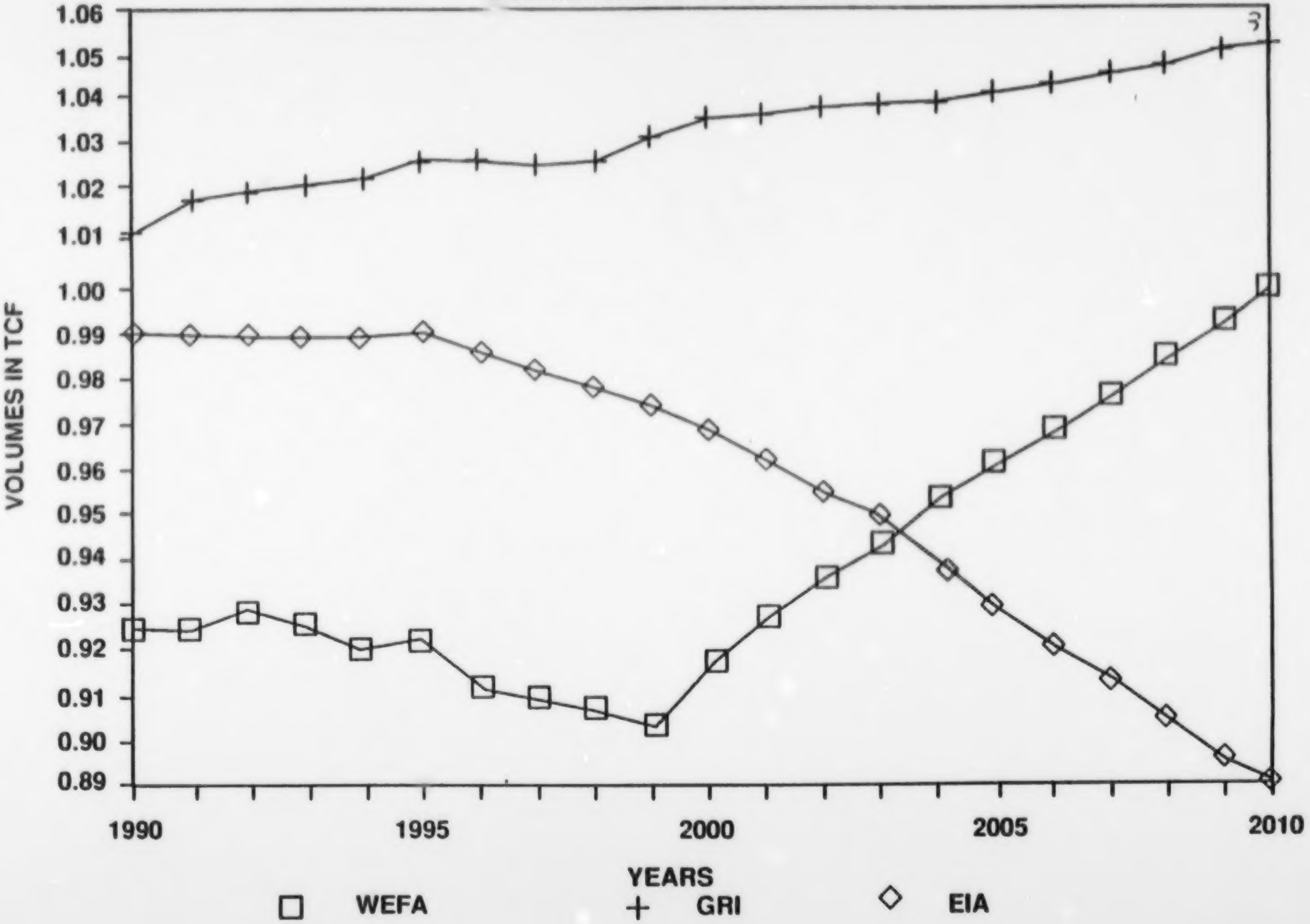
MIDWEST NATURAL GAS DEMAND

RESIDENTIAL MARKET FORECAST



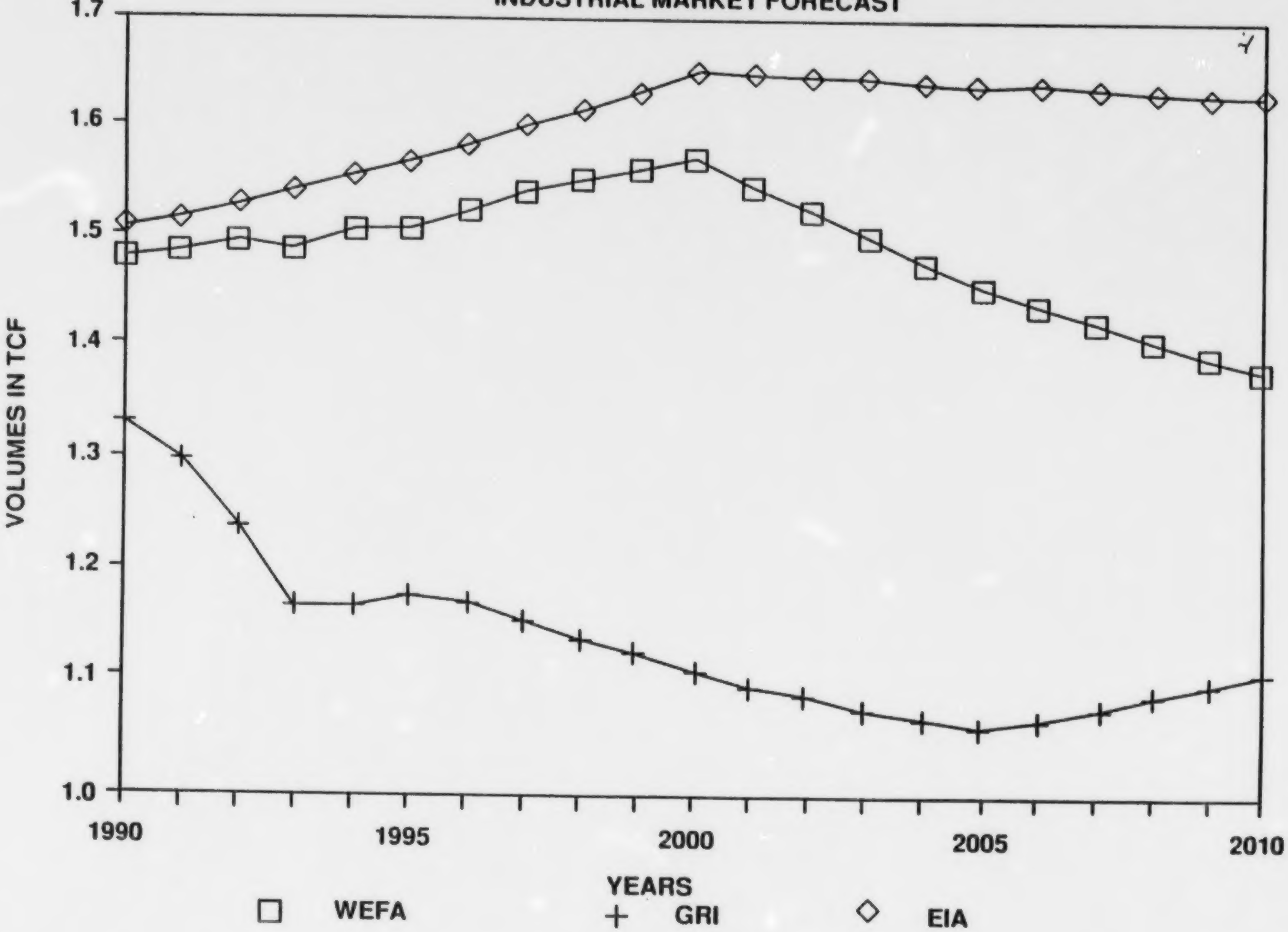
MIDWEST NATURAL GAS DEMAND

COMMERCIAL MARKET FORECAST



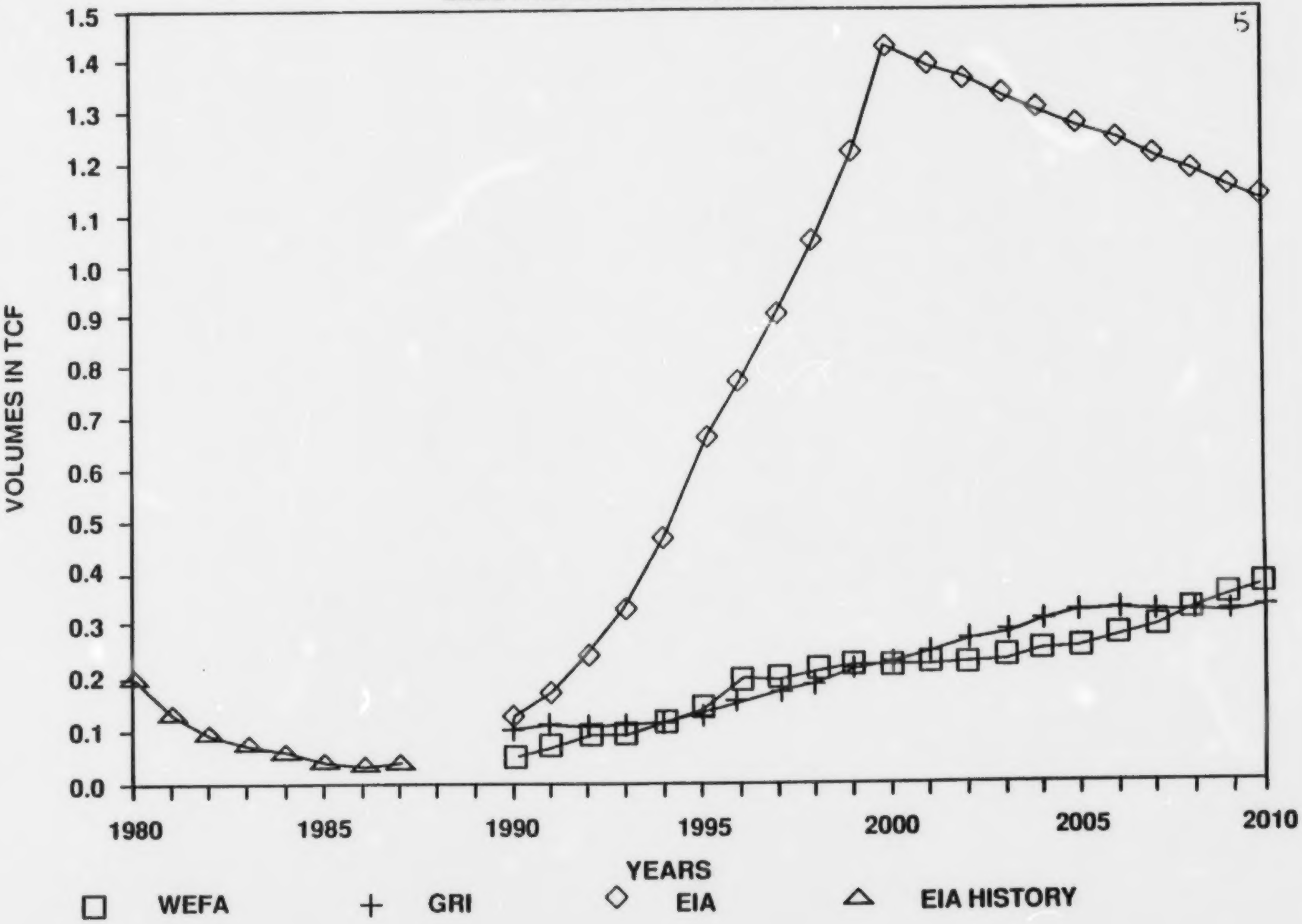
MIDWEST NATURAL GAS DEMAND

INDUSTRIAL MARKET FORECAST



MIDWEST NATURAL GAS DEMAND

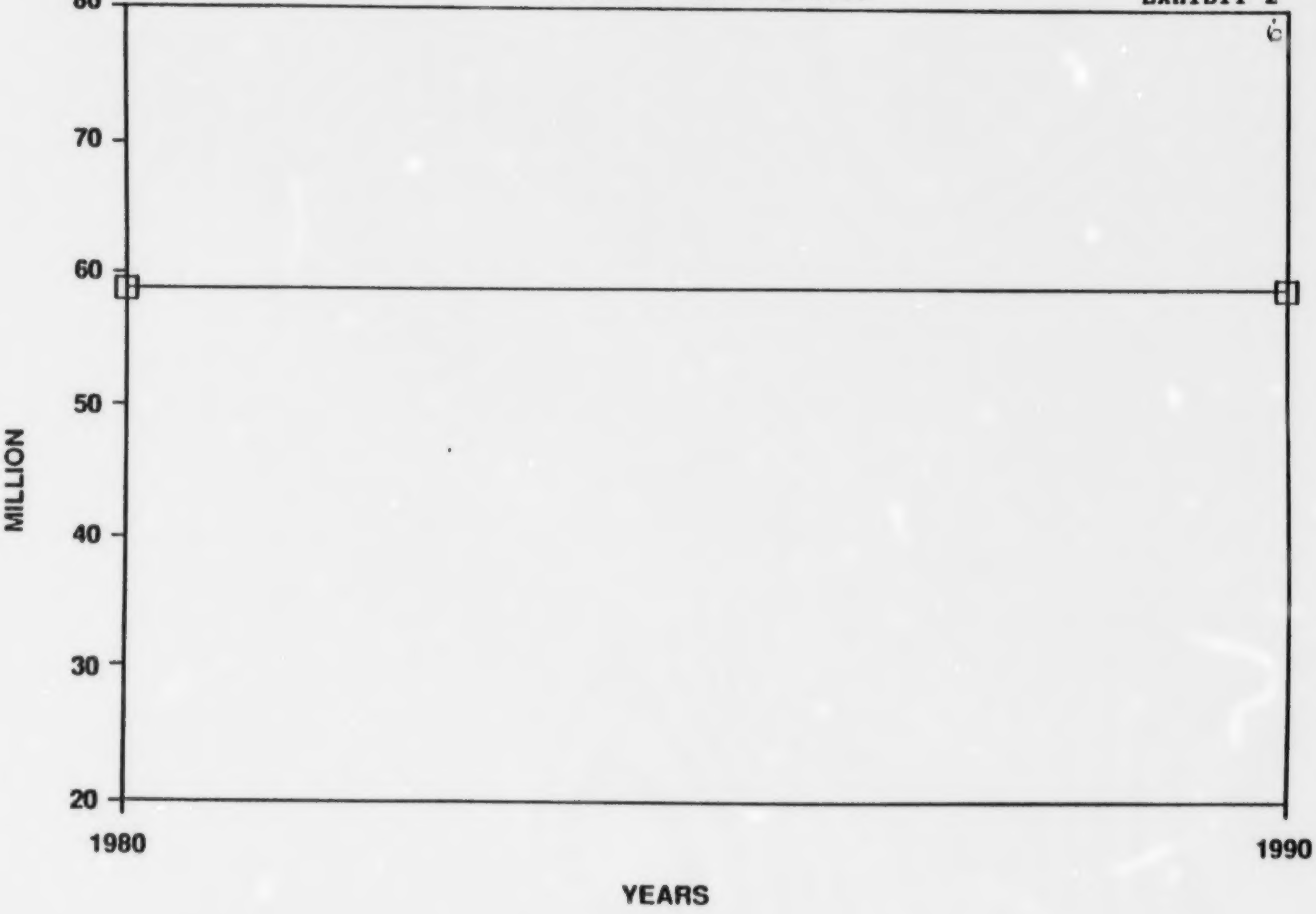
ELECTRIC UTILITIES MARKET FORECAST



POPULATION

MIDWEST UNITED STATES

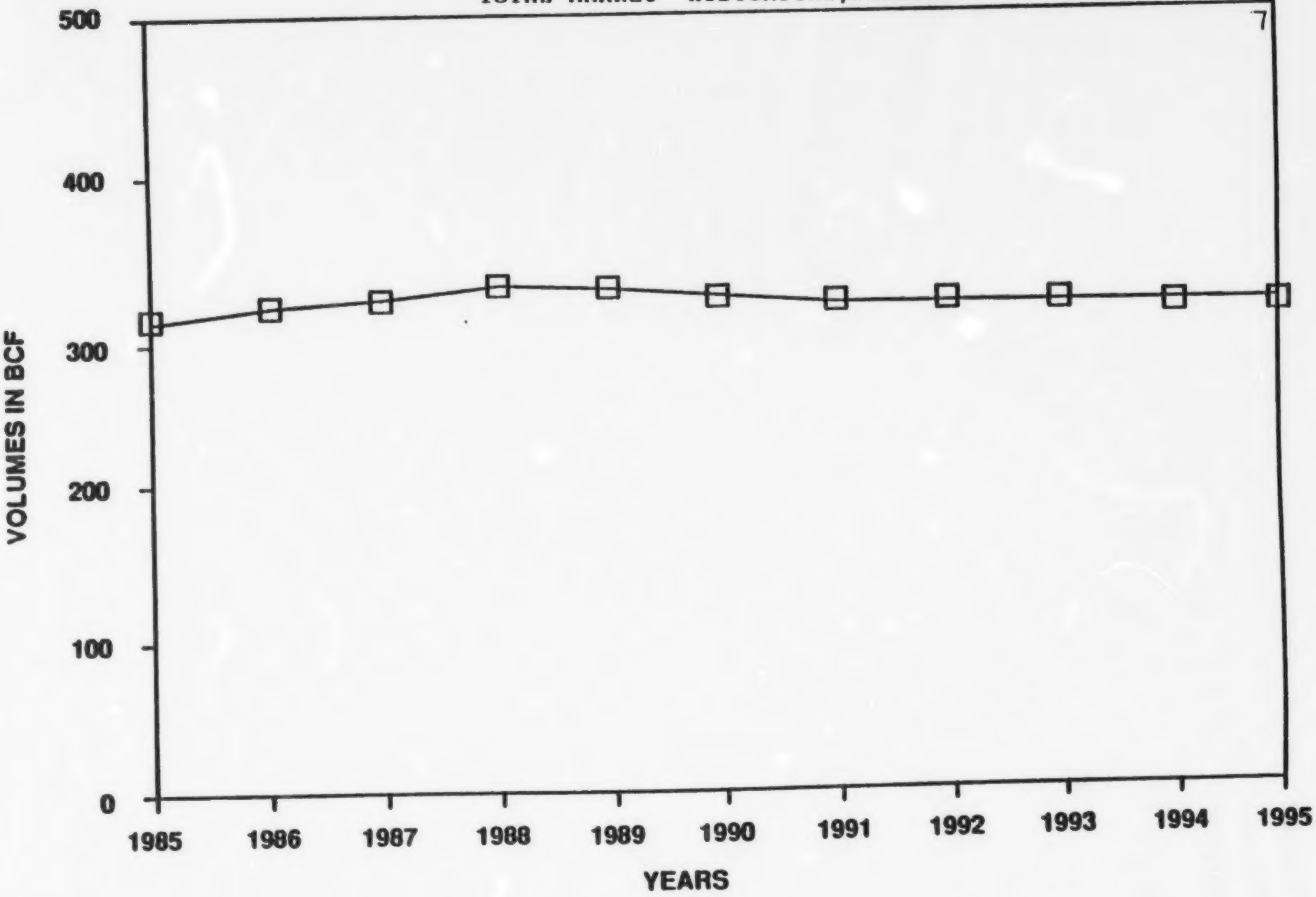
EXHIBIT 2



MICHCON NATURAL GAS DEMAND

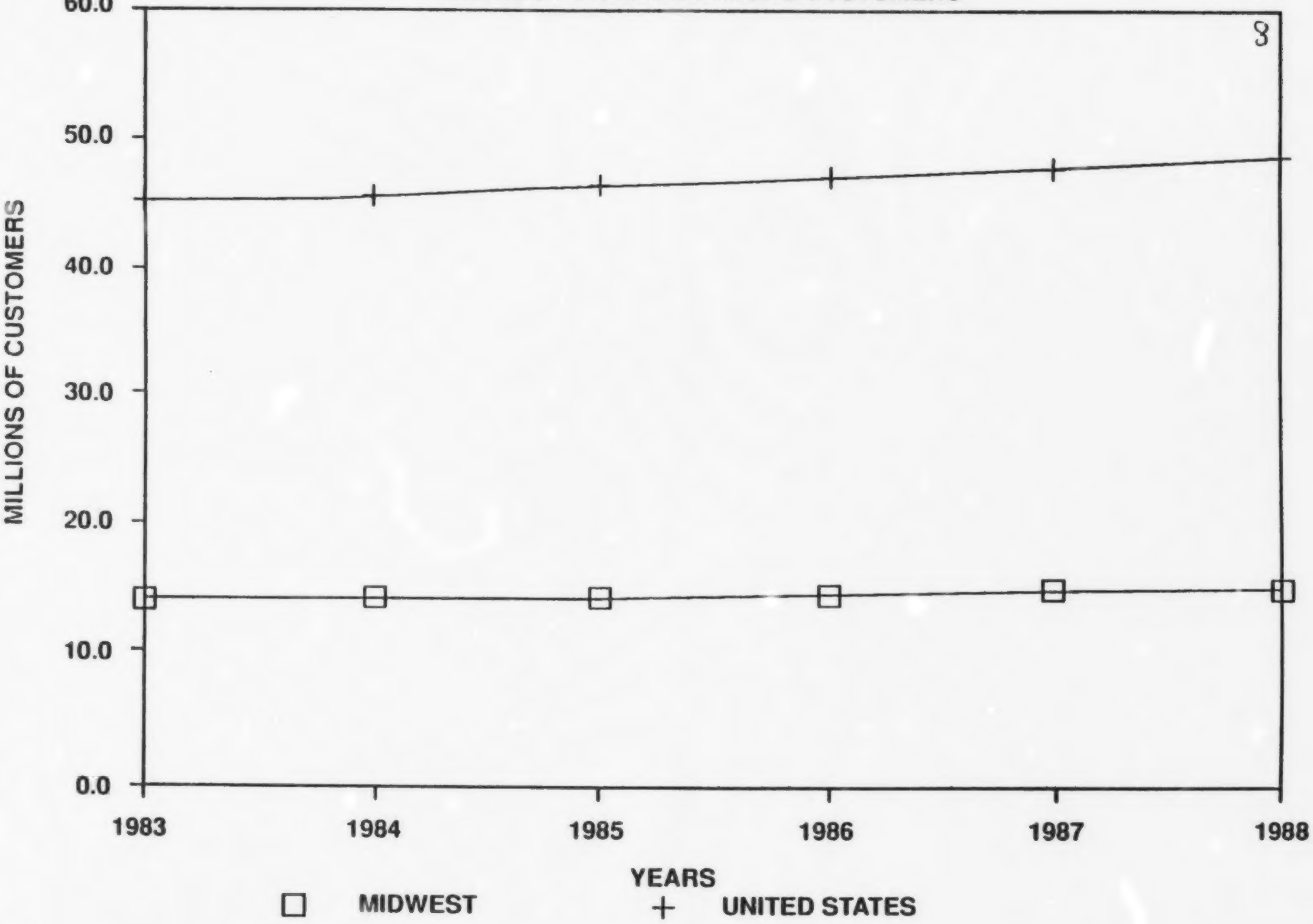
TOTAL MARKET HISTORICAL/FORECAST

EXHIBIT 3



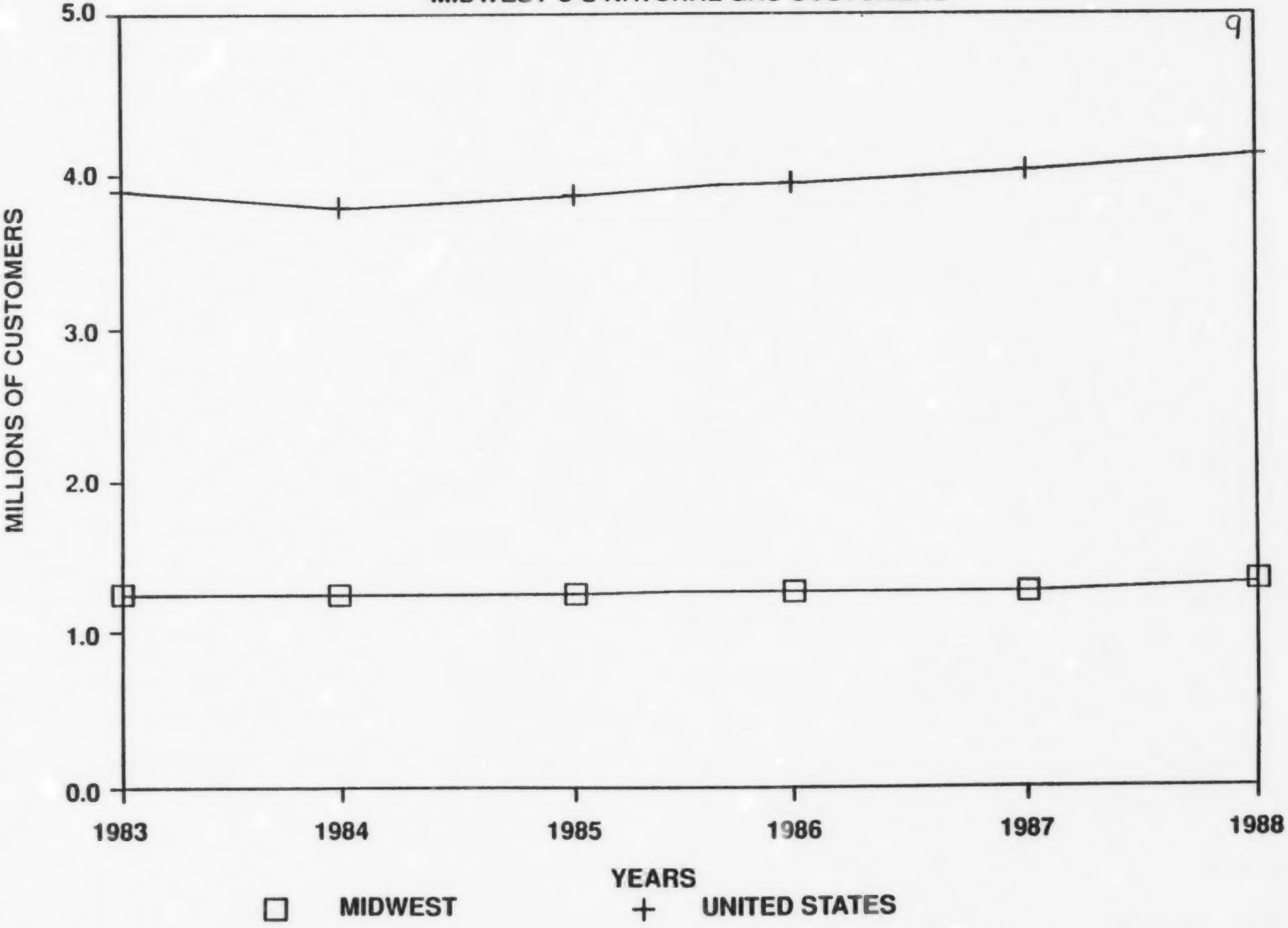
RESIDENTIAL MARKET

MIDWEST U S NATURAL GAS CUSTOMERS



COMMERCIAL MARKET

MIDWEST U S NATURAL GAS CUSTOMERS



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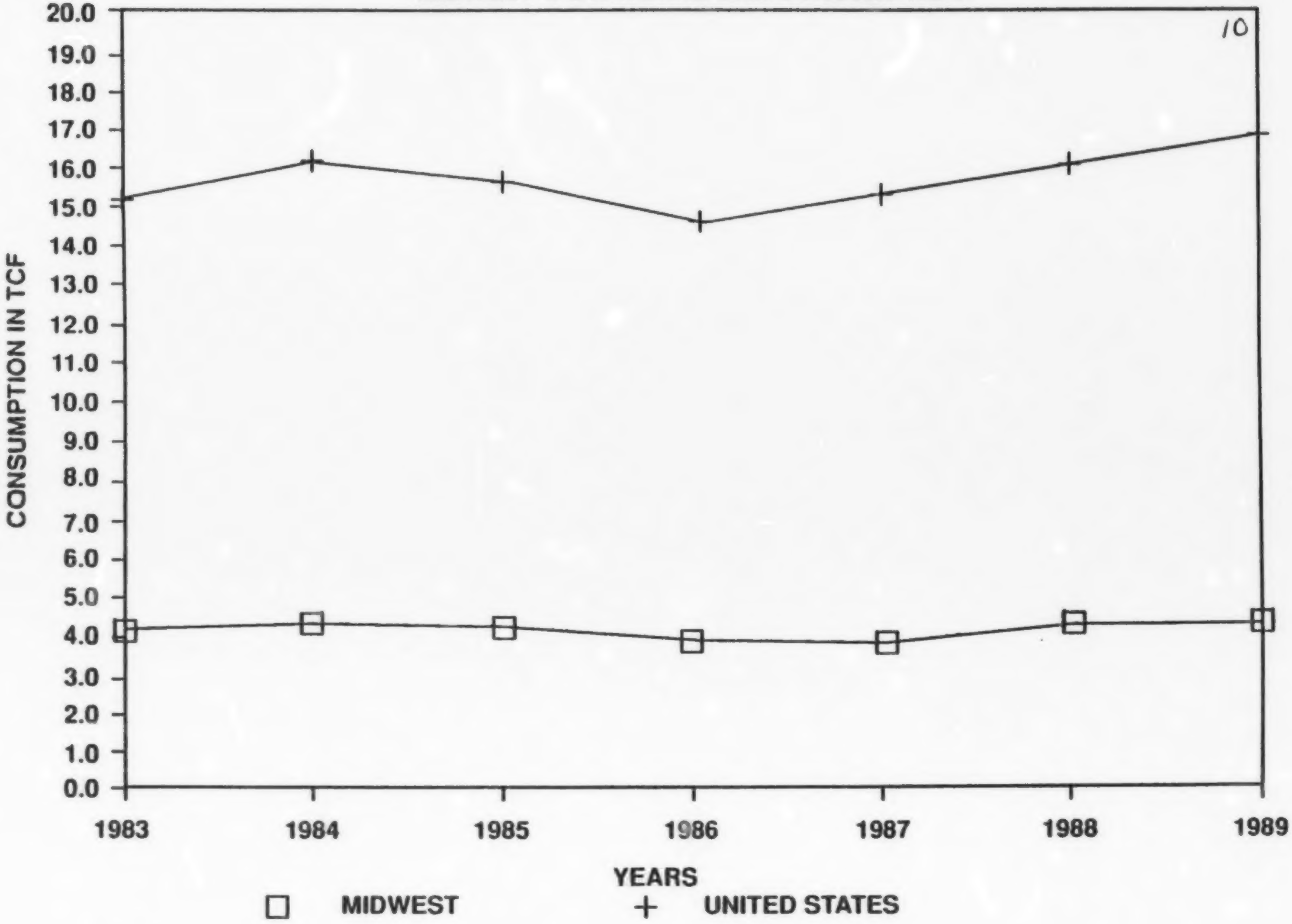
TOTAL NATURAL GAS MARKET

MIDWEST U S NATURAL GAS CONSUMPTION



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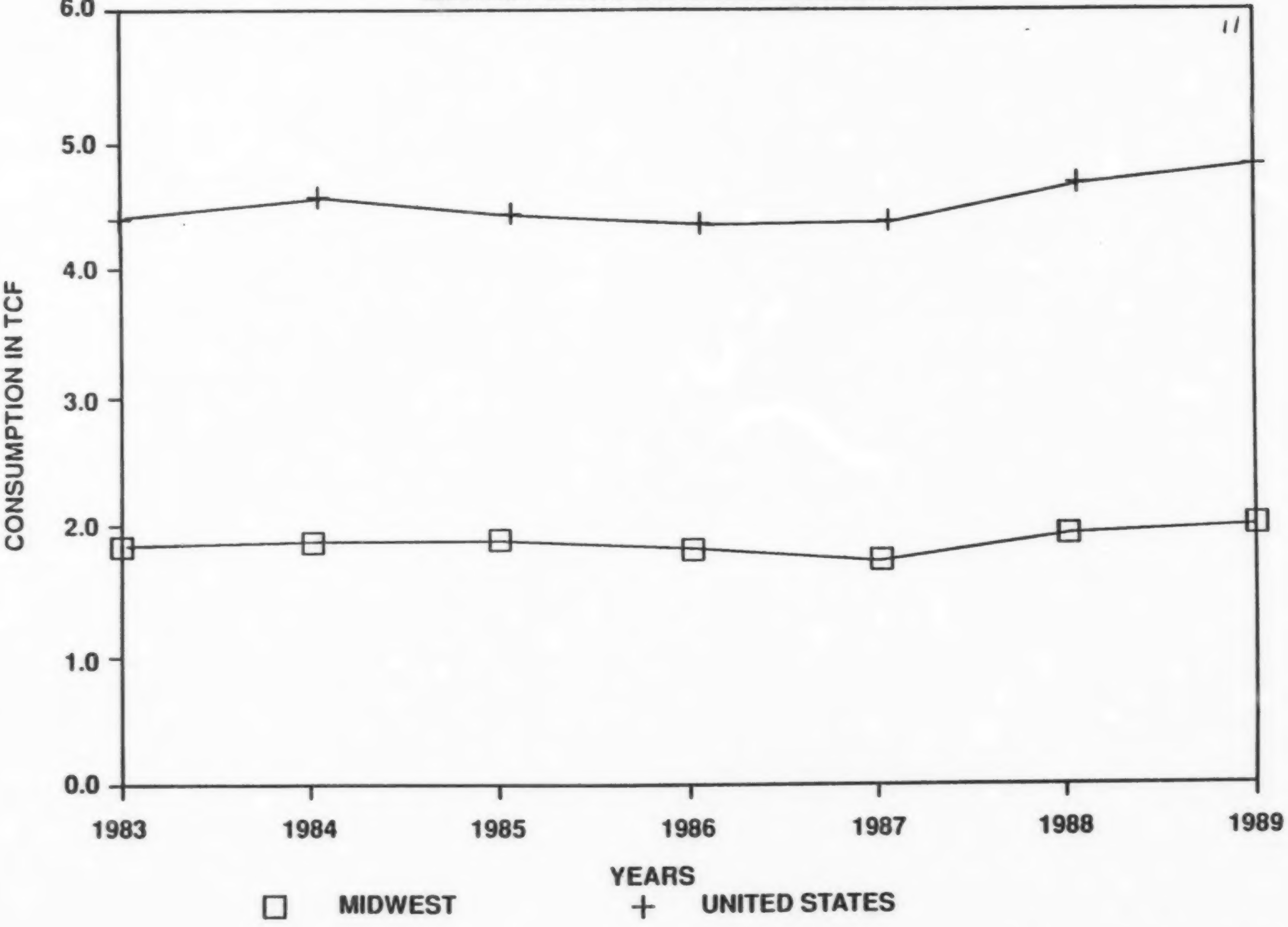
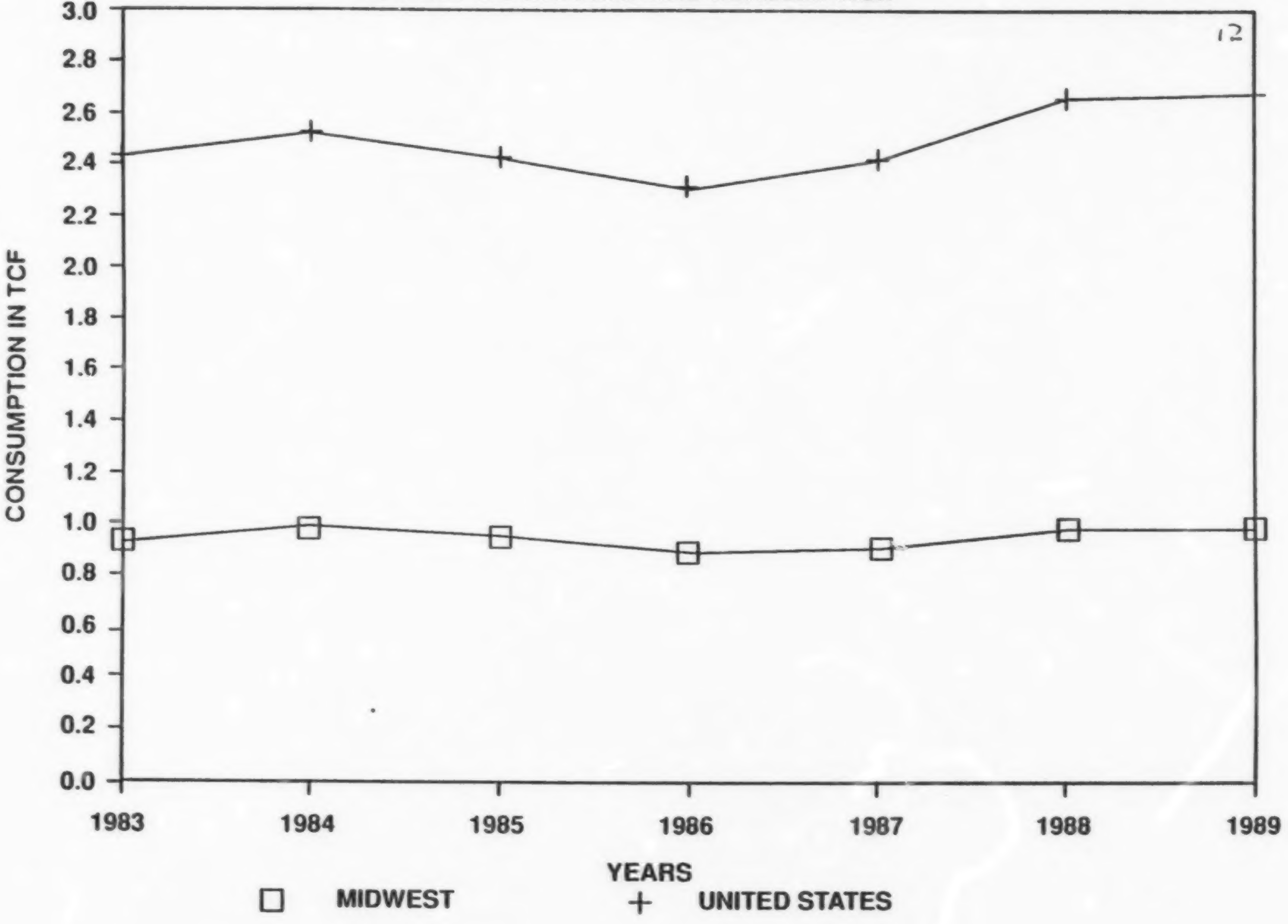
RESIDENTIAL MARKET

MIDWEST U S NATURAL GAS CONSUMPTION



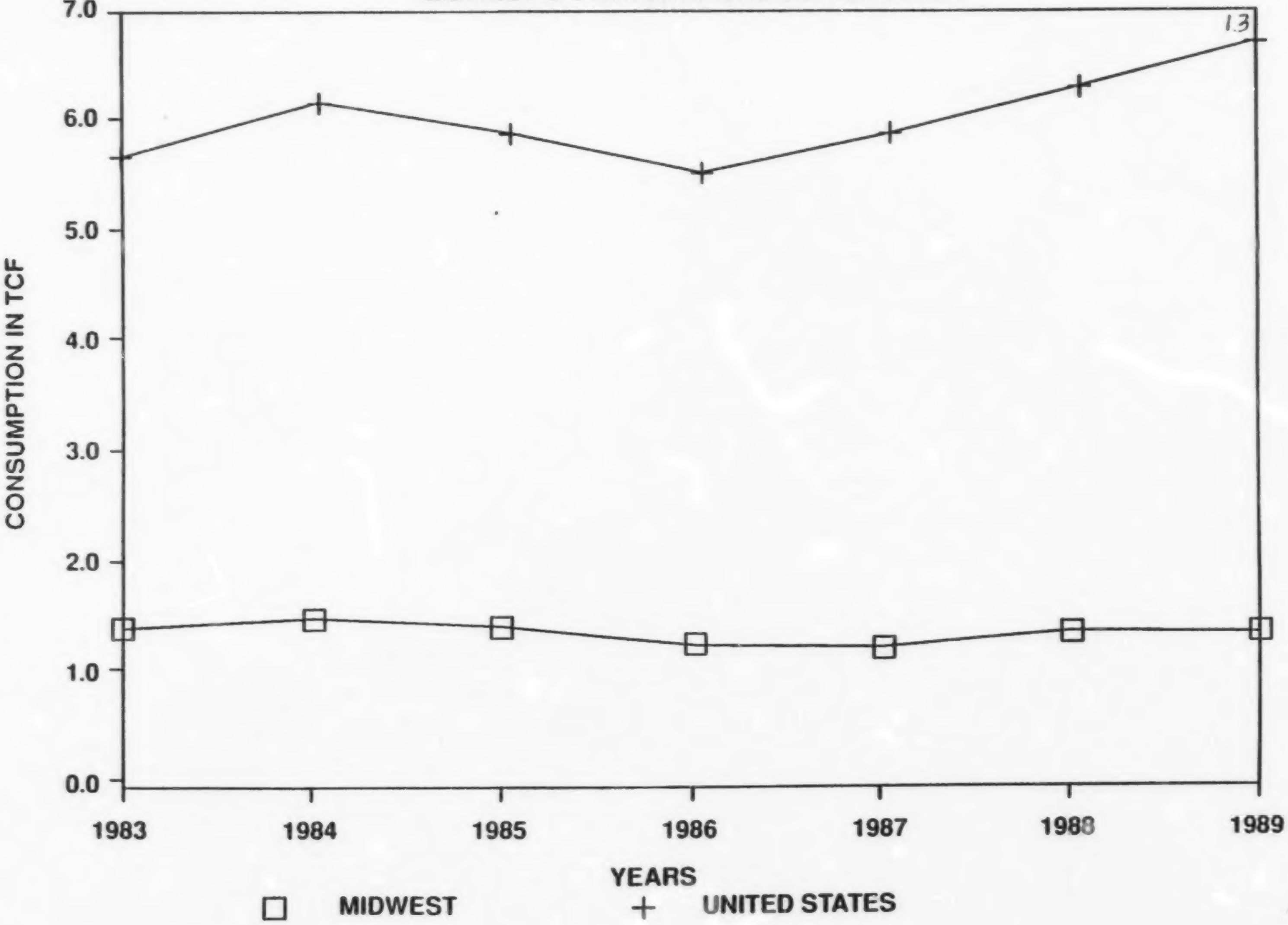
COMMERCIAL MARKET

MIDWEST U S NATURAL GAS CONSUMPTION



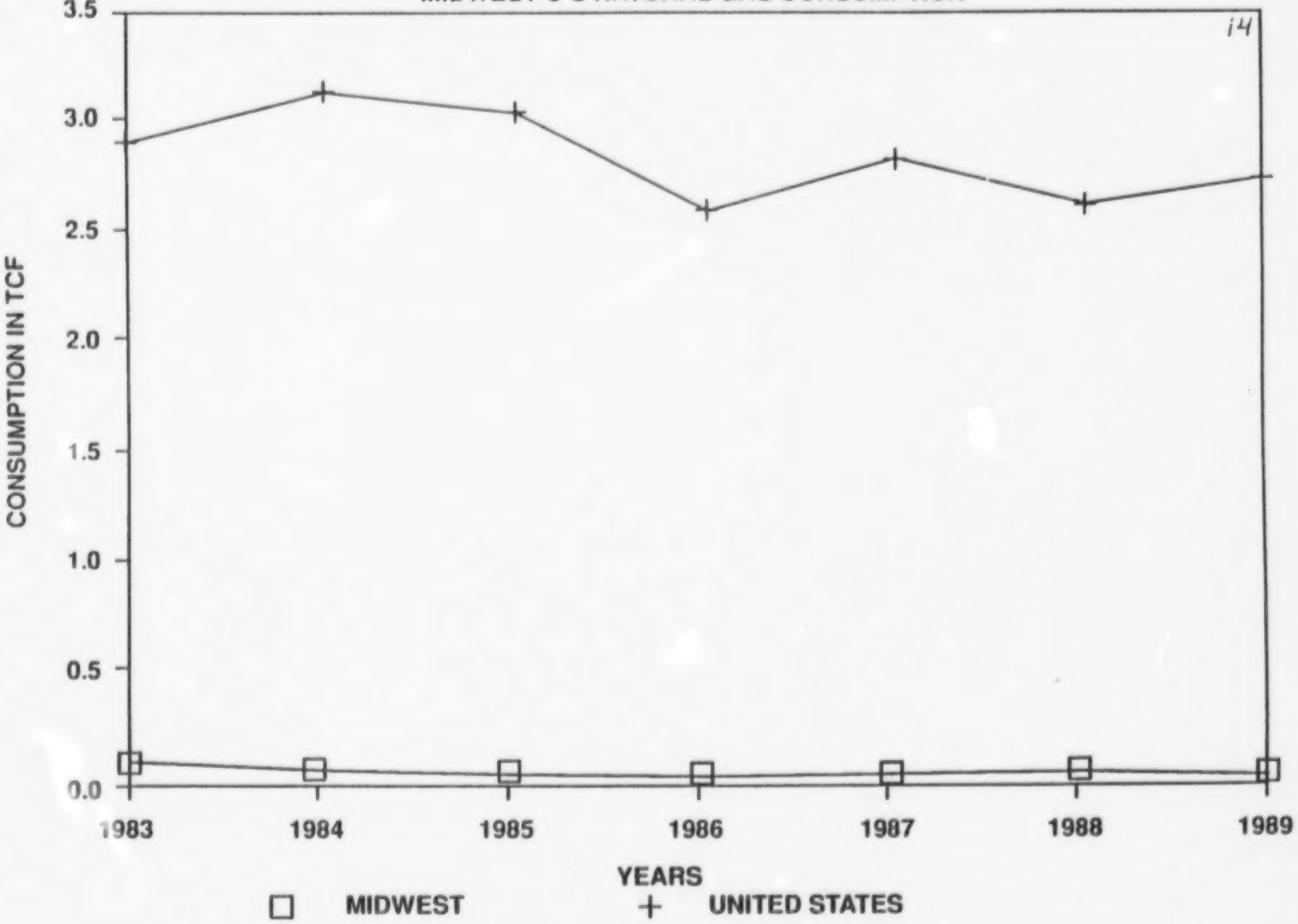
INDUSTRIAL MARKET

MIDWEST U S NATURAL GAS CONSUMPTION



ELECTRIC UTILITY MARKET

MIDWEST U S NATURAL GAS CONSUMPTION



CALIFORNIA MARKET REQUIREMENTS

Presented by

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NINTH CERI INTERNATIONAL
OIL AND GAS MARKETS CONFERENCE
Calgary, Alberta
September 23-25, 1990

The California Economy

Slide 1: California's Place in World Economics

It is a pleasure to be here today to discuss the energy and natural gas requirements of California, the eighth largest economy in the world.

Slide 2: California Employment Pie Chart

California energy suppliers serve the needs of a diverse and vibrant economy which includes the aerospace industry, food processing, crude oil production, and petroleum refining. California is also a world leader in agriculture and electronics manufacturing.

Slide 3: PG&E's Role in the California Market

PG&E's service territory covers 94,000 square-miles in northern and central California, serving roughly 5 percent of the population and income of the entire United States. PG&E is a combined electric-natural gas utility serving over three million natural gas customers. In addition to residential, commercial and industrial customers, PG&E supplies natural gas to its own electric generating facilities, which in turn serves over 4 million electric customers. In 1989, PG&E's total gas throughput, including customer-owned gas transported by PG&E as well as natural gas sold by PG&E, exceeded 950,000 MMcf. This amount is enough gas to serve the annual needs of over 14 million households (based on an average annual residential consumption in PG&E's territory of 67 Mcf during 1989).

Slide 4: California Natural Gas Market Outlook

Today I will discuss California's natural gas market in terms of both the outlook for market requirements, and the expected supplies of natural gas available to fuel that demand. I believe the outlook is very positive. California's economy will continue to be robust; California's population, employment, and income are projected to increase faster than the rest of the nation over the next 20 years. Competition for gas sales to California consumers is also expected to increase dramatically as federal and state regulators increase and diversify natural gas supply options available to California consumers. Competition from alternative energy supplies will also continue, but may be diminished by environmental concerns.

The Result:

> Continued and expanded regulation of utilities aimed at limiting the scope of their market activities and increasing competition among those who supply California energy needs.
>
> More customers, possibly even residential customers, will become increasingly responsible for their individual gas supply decisions.

Future California Market Trends

Slide 5: California Gas Market Outlook

Based on the 1990 California Gas Report, prepared jointly by the California gas utilities, total California gas demand is projected to grow at an annual rate of 1.5% through 2010. This compares to estimates ranging from 0.4% to 1.0% for the rest of the U.S.

Side 6: Forecast of California Gas Requirements

The largest component of this demand growth will come from Enhanced Oil Recovery (EOR) operation to generate steam for heavy oil recovery and from cogenerators who produce and sell electricity. Total California EOR requirements are expected to increase 4.7 percent annually, growing from 577 MMcf per day in 1990 to level off at about 950 MMcf per day in 2000. Moderate annual growth of about 0.5 percent is expected after 2000, assuming a leveling off of oil production. Obviously, the actual volumes consumed will depend greatly on the future prices for both oil and natural gas.

Industrial cogeneration, not associated with EOR, is forecast to increase 3.7 percent annually from 396 MMcf per day in 1990 to level off at about 590 MMcf per day in 2000. Here again, the actual volumes consumed will depend on the success of demand-side management initiatives now being put in place.

California's anticipated economic growth will bring increased demand for electricity. Natural gas will play a significant role in meeting that increased demand in an environmentally acceptable way. Gas demand for utility electric generation will grow annually by about 1.8% through 2010. This forecast is based on an assumed return to normal precipitation and hydroelectric conditions, demand-side management results and current air quality restrictions. This forecast also reflects the permanent shutdown of the Rancho Seco Nuclear Power Plant, and a derating of the Geysers Power Plants due to decreased steam production estimates.

World Political Impacts?

Slide 7: World Impacts?

Of more immediate concern is the impact of the Iraq-Kuwait conflict. Uncertainty in world oil markets and the spike in oil prices caused by the conflict are likely to contribute to a temporary slow-down of the U.S. economy and an increase in the U.S. inflation rate. There exists sufficient additional world capacity to make up any shortfall from the loss of Iraq and Kuwait crude, and it is anticipated that other OPEC and non-OPEC producers will begin to make up the lost production. However, this and other crude oil supply disruptions will increase U.S. concern over energy supply reliability and result in a greater reliance on secure North American natural gas supplies and overland transportation facilities.

New Demand Potential

Slide 8: New Demand Potential

Other significant opportunities for gas demand growth are not reflected in the demand forecast in the California Gas Report. These opportunities include new demand potential tied to southern California oil displacement and the use throughout California of vehicles fueled by compressed natural gas.

The most exciting opportunity is the potential for the significantly unmet preferred demand for natural gas in southern California. The southern California market is faced with proposed air quality policies which mandate lower oil consumption and increased access to natural gas. On a U.S. national level, the passage of the Clean Air Act by Congress will increase public awareness of all environmental issues. In California, recent curtailment of gas-fired power plants in the Los Angeles Basin has brought about a concern to minimize the need for power plants to burn less desirable fuel oil. In addition, the California Public Utility Commission has stated that utilities should endeavor to provide high levels of service for large commercial, industrial and electric power plant customers.

Southern California customers are also interested in lessening their dependence on southwest U.S. gas supplies through purchases of Canadian natural gas. This Canadian gas would be delivered by proposed new pipelines, of which PG&E's subsidiary Pacific Gas Transmission (PGT) is the leading contender.

Gas consumption may increase as requirements for clean air, fuel savings, and fuel security encourages demand for vehicles fueled by compressed natural gas. Compressed natural gas is an ideal fuel for fleet vehicles, and is presently "the fuel of choice" for the U.S. postal fleet in Concord, California. The United Parcel Service has recently announced it will convert its southern California fleet to natural gas. The average fleet vehicle equipped to run on compressed natural gas uses roughly 150 thousand cubic feet of gas per year. Based on a recent study by PG&E, the potential demand for compressed natural gas for fleet and commercial vehicle use in PG&E's service territory is around 14 Bcf per year by the year 2000. Future availability of low-compression storage for private vehicles could boost the use of compressed natural gas substantially.

Factors Influencing Future Natural Gas Markets

In addition to demand growth, California's market is being restructured by the industry's regulators. Many of you are familiar with the new rules being proposed by the California Public Utilities Commission. Implementation of California regulatory policies initiated during the 1980s and continuing into the 1990s, are bringing about a fundamental change in the traditional merchant function performed by the gas utilities -- significantly reducing their role in procuring gas supplies for non-core customers.

Slide 9: Marketing Functions

Today, industrial and large commercial customers may purchase gas directly from a producer, broker or a gas utility. As an alternative to new rules being proposed by the CPUC, PG&E and most other California gas industry participants are currently involved in settlement activities to develop alternative and more workable approaches. One way or the other, however supply alternatives will be provided for California's gas consumers. In addition, there are proposals to allow groups of small commercial customers to aggregate their demand and buy gas directly. These changes, if enacted, will have a profound impact on supply availability for California gas consumers, and will increase competition among gas suppliers for sales to California consumers.

Increased demand and the continued implementation of new California regulatory policies, while extremely challenging, are creating new market opportunities for imaginative gas suppliers, producers, brokers and LDC's.

Existing California Daily Delivery Capacities

Slide 11: Existing Delivery Capacities

California needs additional gas supplies and pipeline capacity to serve these expected demand increases brought about by growth and changing regulatory policies.

Gas supplies from traditional sources will continue to be available to California markets, but competition from new gas sources and new pipeline systems will become more intense. The existing supply and delivery capacities are inadequate to meet California's evolving market opportunities. Existing supply capacities include:

- Southwest supply region through El Paso Natural Gas and Transwestern Pipeline systems, 3.8 Bcf per day.
- Western Canada supply region through PGT, 1.0 Bcf per day.
- California supply sources, declining rapidly during the past several years, 0.6 Bcf per day.

Proposed Pipelines to California:

Slide 10: Need for New Interstate Pipeline Capacity

Driven by the desire to connect new market opportunities with supplies, as many as eight major interstate pipeline projects have been proposed. The proposals to expand existing pipeline systems and construct new pipelines provide new opportunities for increased direct access to supplies and transportation capacity for all customers. The California Public Utilities' review of interstate natural gas pipeline supply and capacity available to California concluded the following:

- There is a need for at least an additional 900 MMcf per day to California by 1995, and 1.6 to 2.1 Bcf per day in the long term.
- Proposed new pipeline capacity will not only satisfy that additional need, but will also provide opportunities for increasing supply diversity and enhancing the level of transportation service to noncore customers; while promoting gas-on-gas and pipeline-on-pipeline competition.

Availability of Additional Supplies

Slide 12: Supply Availabilities

Given the need for increased pipeline capacity into California, we can take some comfort in the current availability of additional supplies to meet California's needs. Proved and potential North American gas reserves are estimated to be approximately 1.3 quadrillion cubic feet: some 69 percent of the total is in the U.S., including Alaska, with the remaining 31% located in Canada. The more instructive reserve-to-production ratio indicates that, at the current rate of production, the U.S. has a 58-year supply of gas. Canada, because of a significantly lower production rate and a much less developed gas resource base, has a 142-year supply.

Canada's productive capacity should continue to exceed the demand for both domestic use and expected export capacity. If Canadian supply gains greater access and continues to be competitively priced, it will maintain or expand its share of the U.S. market.

Pipeline Capacity Expansion Proposals

Slide 13: Proposed Pipeline Projects

New Interstate Pipeline and Expansion Proposals include:

- **Mojave Pipeline Company**

  Mojave Pipeline Company proposes to deliver 400 MMcf/d of Southwest U.S. supplies from Arizona to Kern County by 1991. The Mojave pipeline will tap extensive coal seam reserves located in the San Juan Basin. Currently, about 300 wells produce coalbed methane, mainly from the Fruitland coal seam in New Mexico. The state of New Mexico has estimated recoverable coalbed reserves to be in the range of 15 Tcf. Conventional reserves are also estimated to be at the 15 Tcf level.

- **Kern River Pipeline Company**

  Kern River Gas Transmission Company proposes to supply from 700 MMcf/d to over 1 Bcf/d from Wyoming to Kern County in 1991. Kern estimates Rocky Mountain total proven uncommitted reserves at about 4.0 Tcf from all major basins and the overthrust belt.

- **Wyoming-California Pipeline Company**

  The Wyoming-California Pipeline Company (WyCal) proposes to deliver 500 MMcf/d from Wyoming into California by 1991. Its reserve access is the same as for Kern River.

- **Altamont Gas Transportation**

  The Altamont Gas Transportation Project proposes to deliver 700 MMcf/d from Alberta to Wyoming by 1993. Canadian gas could move on to California via an expanded Kern River or another project.

- **PGT/PG&E Expansion Project**

  The PGT/PG&E Pipeline Expansion Project is our proposal to deliver 148 MMcf/d from Canada to the northwest U.S., and 755 MMcf/d to southern California in 1993. Current proved reserves in the Western Canada Sedimentary Basin are estimated by the National Energy Board to be about 71 Tcf. Estimates of total proved gas reserves in the frontier areas of Beaufort Sea, Mackenzie Delta, Arctic Islands and Eastern Canada range from 32 to 35 Tcf.

In addition to these proposals, expansion projects have been proposed for Transwestern Pipeline, El Paso Natural Gas Company, and Southern California Gas Company totaling 480 MMcf per day of additional capacity. Other proposals for new pipelines also exist, including proposals for imports of Mexican gas to California -- or Texas gas via Mexico.

Clearly, if you add up all of the proposed capacity, California would be awash in gas. But the market will determine the supply it needs, and the financier will bankroll the chosen.

PG&E's Response to Growing Demand

PG&E plans to meet additional supply and capacity needs within its service territory by expanding its underground storage capacity and by participating in the PGT and WyCal projects. PG&E current plans call for transporting 100 MMcfd on the PGT expansion, and 50 MMcfd on WyCal. In preparing for an uncertain future, we have to develop flexible and robust plans that cover a range of contingencies and strategies. Also, more and more, we have to think about both "obligations to serve" and "opportunities to serve," and the regulatory mechanisms that govern each.

Conclusion

Slide 14: Conclusion

- Natural gas will play an expanded role in meeting California's future energy needs as clean fuel policies being developed by local and state agencies accelerate the rate of growth in natural gas demand.

- The continued industry restructuring is creating new market opportunities for customers seeking supply alternatives, producers who want to supply natural gas, and pipelines who want to provide the transportation required. However, each party will have to do so in an uncertain environment with new rewards and new risks.

- New interstate pipeline capacity will assure access to reliable and competitive gas supplies to meet California's energy and environmental goals, but it's a real horse race.
- The U.S. and Canada have ample natural gas resources which can be developed over time -- and with proper incentives to satisfy the growing need.
- Competition to serve California's expanding natural gas markets will intensify significantly as regulations increase procurement options available to California consumers, and as projects to bring additional gas to California are constructed.

In order to assure successful changes in the California market, the various regulatory bodies involved must recognize and balance the interests of the major parties involved and provide a reasonable transition period in order to adjust the business arrangements currently in place. In an increasingly market-driven environment, no single industry segment can long gain an advantage over another without precipitating a contrary and self-defeating counter reaction a few years down the road. As in most cases, over time, the parties in any transaction rise and fall together.